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THE FOOD OF THE DARTERS.

BY S. A. FORBES.

WHAT the humming-birds are in our avifauna, the "darters" are among our fresh-water fishes. Minute, agile, beautiful, delighting in the clear, swift waters of rocky streams, no group of fishes is more interesting to the collector; and in the present state of their classification, none will better repay his study. Notwithstanding their trivial size, they do not seem to be *dwarfed* so much as *concentrated* fishes—each carrying in its little body all the activity, spirit, grace, complexity of detail and perfection of finish to be found in a perch or a "wall-eyed pike."

To the entertaining and instructive account of the sub-family given by Jordan and Copeland in former numbers of the NATURALIST,[1] I propose to add a few notes on their food, based upon a study of the contents of seventy stomachs, and to point out some of the correlations between structure and habit, with a view to accounting for the origin of the group.

These seventy specimens represented fifteen species, collected in all parts of Illinois, in several months of four successive years. They indicate much more than their number would imply, since from those collected at each time and place, as many were commonly studied as were necessary to give a full idea of the food of the species then and there. The different individuals from the

[1] "Johnny Darters." By D. S. Jordan and H. E. Copeland. AM. NAT., Vol. x, No. 6, June, 1876, pp. 335–341.

"The Sand Darter." By D. S. Jordan and H. E. Copeland. AM. NAT., Vol. xi, No. 2, Feb., 1877, pp. 86–88.

same date and locality usually agreed so closely in food, that the study of from two to five gave all the facts obtainable from several times as many. The data here given, therefore, really exhibit the food of the family at different seasons in twenty-nine localities within the State.

The genus *Pleurolepis* is comparatively rare in Illinois, as there are few of the sandy streams in the State, which it inhabits. Seven individuals were examined—four of *P. pellucidus* and three of *P. asprellus*. The food of these specimens was remarkably uniform—the only elements found being the larvæ of small diptera and Ephemerids. Eighty-one per cent. of the food of all consisted of the larva of Chironomus,[1]—a small, gnat-like insect,—twelve per cent. of the larva of other small diptera, and the remaining seven per cent. of Ephemerid larvæ (May flies).

Twelve specimens of the genus *Alvordius* were studied—seven of *maculatus* and five of *phoxocephalus*.[2] These represented five different localities and dates. This is a larger species than the preceding, and to this fact is probably due the predominance (seventy-five per cent.) in its food of the larvæ and pupæ of May flies (Ephemeridæ). These included four per cent. of the larvæ of *Palingenia bilineata* Say, one of the largest Ephemerids in our streams. The remaining kinds were larvæ of dragon flies (Agrionini), four per cent.; larvæ of Chironomus, seven per cent., and *Corixa tumida* Uhl., thirteen per cent.

The genus *Boleosoma*, regarded by Dr. Jordan as the typical darter, was represented by twelve specimens from eight localities—nine of *maculatum*, two of *olmstedi* and one of *camurum*.[3] These specimens show but slight food differences from other darters of similar size; the only notable variation being the appearance of fifteen per cent. of case-worms (larvæ of Phry-

[1] The larvæ of Chironomus are among the most important elements of fish food in our waters, appearing in abundance in the stomachs of the young of a great variety of species. They have been too little studied in this country to allow specific determination.

[2] The classification used in this paper is that of the second edition of Jordan's Manual of Vertebrates.

[3] *Boleosoma maculatum* and *B. olmstedi* should undoubtedly be united. Specimens in the laboratory collection present the extremes of both forms, together with numerous intermediate stages of each character used to distinguish them.

This whole group exhibits a surprising variability, perhaps due to its comparatively recent origin.

ganeidæ). Sixty-six per cent. of the food was Chironomus larvæ, seven per cent. larvæ of other minute diptera (including Simulium), and the remaining eight per cent. was larvæ of small Ephemerids.

I studied the food of two specimens of *Pœcilichthys variatus*, four of *P. spectabilis* and two of *P. asprigenis*—making eight of the genus, representing six localities. Fifty-eight per cent. of small larvæ of diptera (forty-nine per cent. of Chironomus), thirty-two per cent. of larvæ and pupæ of small Ephemerids, and ten per cent. of case-worms made up the entire bill of fare.

Percina caprodes, the largest of the group, departs from all the foregoing species by the introduction of crustacean food—thirty per cent. of Entomostraca and three per cent. the smallest of our Amphipoda, *Allorchestes dentata* (Smith) Faxon. Most of the Entomostraca were *Cladocera*, including Daphnia, Eurycercus and Daphnella.[1]

Here occurred the only instance of molluscan food in the group. One specimen had taken a few individuals of *Ancylus rivularis* Say. Reduced ratios of Chironomus and Ephemerid larvæ, and a few *Corixa tumida* complete the list.

Of *Nanostoma zonale*, less common than the others, but two individuals were examined, and these had eaten nothing but larvæ of small diptera, including sixty-five per cent. of Chironomus.

Six specimens of *Etheostoma flabellare* var. *lineolata*, from four localities, had eaten sixty-one per cent. of Chironomus larvæ, twenty-seven per cent. larvæ of small Ephemerids, and twelve per cent. of Copepoda (Cyclops).

Boleichthys elegans, found only in the southern part of the State (three specimens examined), had eaten only dipterous larvæ (thirty-seven per cent.) and Ephemerid larvæ (sixty-three per cent.). This is a larger, heavier species than most of the others, and, therefore, like Alvordius, prefers Ephemerids to gnats.

Last and least comes *Microperca punctulata*, represented by nine specimens from four localities in Northern Illinois. This smallest of the darters shares with Percina, the largest, the peculiarity of crustacean food, which made up sixty-four per cent. of the total. The principal kinds were Cyclops, Chydorus, young

[1] Daphnella was found in a Percina from the Calumet river, at South Chicago, but not in condition to permit the determination of the species.

Gammarus fasciatus Say, and young *Crangonyx gracilis* Smith. The remaining elements were Chironomus larvæ (thirty-four per cent.) and a trace of Ephemerids (two per cent.).

It will be seen that the family, taken as a whole, divides into two sections, distinguished by the presence or absence of crustacean food. This is easily explained by the fact that Percina and Microperca range much more freely than the other genera—being frequently found among weeds and Algæ in comparatively slow water with muddy bottom, while the others are rather closely confined to swift and rocky shallows.

In discussing the food of the whole group, taken as a unit, it may best be compared with the food of the young of other percoids. It is thus seen to be remarkable for the predominance of the larvæ of Chironomus and small Ephemeridæ—the former of these comprising forty-four per cent. and the latter, twenty-three per cent. of the whole food of the seventy specimens. In young black bass *(Micropterus pallidus)* on the other hand, the averages of nine specimens, ranging from five-eighths inch to one and a half inches in length, were, in general terms, as follows: Cladocera forty-two per cent., Copepoda seven per cent., young fishes twenty per cent., Corixa and young Notonecta twenty-nine per cent., and larval Chironomus only two per cent. The search for the cause of this difference leads naturally to an examination of the whole economy of these little fishes, and opens up the question of their origin as a group.

The close relation of the Etheostomatinæ to the Percidæ proper, requires us to believe that the two groups have but recently diverged, if, indeed, they are yet distinctly separate.

We must inquire, therefore, into the causes which have operated upon a group of percoids to limit their range to such apparently unfavorable situations, to diminish their size, to develop unduly the paired fins and reduce the air-bladder, to remove the scales of several species more or less completely from the head, breast, neck and ventral region, and to restrict their food chiefly to the few forms mentioned above

No species can long maintain itself anywhere which cannot, in some way, find a sufficient supply of food, and also protect itself against its enemies. In the contest with its enemies it may acquire defensive structures or powers of escape sufficient for its protection, or a reproductive capacity which will compensate for

large losses, or it may become adapted to some place of refuge where other fishes will not follow. What better refuge could a harrassed fish desire than the hiding places among stones in the shallows of a stream, where the water dashes ceaselessly by with a swiftness few fish can stem? And if, at the same time, the refugee develops a swimming power which enables it to dart like a flash against the strongest current, its safety would seem to be ensured. But what food could it find in such a place? Let us turn over the stones in such a stream, sweeping the roiled water at the same time with a small cloth net, and we shall find—larvæ of Chironomus and small Ephemerids and other such prey, and little else; food too minute and difficult of access to support a large fish, but answering very well if our immigrant *can keep down his size*. Here the principles of natural selection assert their power. The limited supply of food early arrests the growth of the young; while every fish which passes the allowable maximum is forced for food to brave the dangers of the deeper waters where the chances are that it falls a prey. On the other hand, the smaller the size of those which escape this alternative, the less likely will they be to attract the appetite of the small gar or other guerilla which may occasionally raid their retreat, and the more easily will they slip about under stones in search of their microscopic game.[1]

Like other fishes, the darters must have their periods of repose, all the more urgent because of the constant struggle with the swift current which their habitat imposes. Shut out from the deep still pools and slow eddies where the larger species float suspended in mid stream, they are forced to spend their leisure on or beneath the bottom of the stream, resting on their extended pectorals and anal, or wholly buried in the sand. Possibly this fact is correlated with the absence or rudimentary condition of the air-bladder; as it is a rule with many exceptions—but still, probably, a rule—that this organ is wanting in fishes which live chiefly at the bottom.

Doubtless the search for food has much to do with this selection of a habitat. I have found that the young of nearly all species of our fresh-water fishes are competitors for food, feeding almost entirely on entomostraca and the larvæ of minute

[1] In Boleosoma, which is normally scaled in front of the dorsal fin, we often find the skin of this region bare in large specimens, and showing evident signs of rubbing.

diptera.[1] As a tree sends out its roots in all directions in search of nourishment, so each of the larger divisions of animals extends its various groups into every place where available food occurs, each group becoming adapted to the special features of its situation. Given this supply of certain kinds of food, nearly inaccessible to the ordinary fish, it is to be expected that some fishes would become especially fitted to its utilization. Thus the Etheostomatinæ as a group are explained, in a word, by the hypothesis of the progressive adaptation of the young of certain Percidæ to a peculiar place of refuge and a peculiarly situated food supply.

Perhaps we may, without violence, call these the mountaineers among fishes. Forced from the populous and fertile valleys of the river beds and lake bottoms, they have taken refuge from their enemies in the rocky highlands where the free waters play in ceaseless torrents, and there they have wrested from stubborn nature a meagre living. Although diminished in size by their continual struggle with the elements, they have developed an activity and hardihood, a vigor of life and glow of high color almost unknown among the easier livers of the lower lands.

The appended table will facilitate a comparison of the records of the different genera. The percentages were obtained by estimating carefully the ratios of each element of the food of each individual, and averaging these ratios for all the individuals of a species:

DETAILS OF THE FOOD OF THE ETHEOSTOMATINÆ.

	Pleurolepis.	Alvordius.	Boleosoma.	Poecilichthys.	Percina.	Nanostoma.	Etheostoma.	Boleichthys.	Microperca.
Number of specimens.....	7	12	12	8	11	2	6	3	9
I. MOLLUSCA.....					01				
Ancylus rivularis Say.....					01				
II. INSECTA	100	99	96	100	65	100	88	100	36
1. Diptera	93	07	73	58	43	100	61	37	34
Undetermined larvæ ...	12	01	07	09	02	35		10	
Chironomus larvæ	81	06	66	49	41	65	61	27	34
" pupæ									
2. Hemiptera.....		13			05				
Corixa.....		13			05				
Undetermined.....					03				
Larvæ.....		07			02				
C. tumida Uhl.....		06							

[1] The Catostom[at]idæ (suckers) are an exception to this rule, feeding when young chiefly on Algæ and Protozoa.

	Pleurolepis.	Alvordius.	Baleosoma.	Poecilichthys.	Percina.	Nanostoma.	Etheostoma.	Boleichthys.	Microperca.
3. Neuroptera	07	79	23	42	17		27	63	02
Ephemeridæ	07	75	08	32	09		27	63	02
Pupæ		08		14					
Larvæ	07	63	08	18	09		27	63	02
Palingenia		04							
Agrionini (pupæ)		04							
Phryganeidæ (larvæ)			15	10	08				
III. CRUSTACEA		01	04		33		12		64
1. Amphipoda					03				12
Gammarus, yg.									06
Crangonyx "									06
Allorchestes dentata Sm.					03				
2. Ostracoda					01				06
Cypridida					01				06
Undetermined					01				
Cypris									
3. Cladocera					24				27
Undetermined					05				
Daphniidæ					06				
Daphnia					07				
Sididæ					05				
Daphnella					05				
Lynceidæ					01				03
Chydorus									24
Eurycercus					01				
4. Copepoda		01	04		05		12		19
Cyclops		01	04		05		12		19
Confervoid Algæ					01				

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ON THE FORMER EXTENT OF THE TRIASSIC FORMATION OF THE ATLANTIC STATES.[1]

BY ISRAEL C. RUSSELL.

NEARLY two years since I read a paper before the New York Academy of Sciences, on the Physical History of the Triassic Formation in New Jersey and the Connecticut valley,[2] in which many reasons were given for concluding that the Triassic rocks of these two regions were detached portions of one estuary formation.

As several papers have been published relating to the Triassic rocks of the Atlantic States since my essay was written, increasing our knowledge of the subject, and as my interpretation of the geological records has not been accepted by some geologists, I

[1] Read before the New York Academy of Sciences, March 22, 1880.

[2] Annals of the N. Y. Acad. of Sci., Vol. I, No. 8 (1878), pp. 220–254.

take the present opportunity to briefly restate the substance of my former paper which seems to have been partially misunderstood, together with a brief review of the evidence that has since been gathered.

The broad generalization advanced in the essay mentioned above, was, that all the detached areas of Triassic rocks, from South Carolina northward to Connecticut and Massachusetts, are portions of one great estuary deposit, which has been broken up into separate areas by upheaval and denudation. The immediate aim of the paper, however, was to prove the former connection of the Triassic rocks of New Jersey with those found in the Connecticut valley. The conclusion arrived at from the study of the rocks of these two areas, was, that they are the marginal portions of an estuary deposit, the central region having been subsequently upheaved and greatly eroded. The Triassic rocks in this region thus fill a synclinal trough, the longer axis of which has been upheaved into a broad anticlinal. The facts that lead to this conclusion may be briefly stated as follows:

First. The Triassic rocks in New Jersey dip to the westward at an average angle of about fifteen degrees, while the corresponding beds along the Connecticut river are inclined to the eastward at a somewhat larger angle; thus suggesting that they are portions of one great anticlinal.

Second. Each area is an incomplete estuary formation, having only one line of shore deposits. This is shown in the case of the New Jersey area by the fact that all along the line of bluffs bordering the formation on the west occurs a coarse conglomerate which we have shown to be a shore deposit, derived from the bluffs of crystalline rock to the westward. In the finer sandstones and shales associated and interstratified with this conglomerate are ripple marks, sun cracks, raindrop impressions and the footprints of animals, proving beyond question that this was the shore of the basin in which the Triassic rocks were deposited. Throughout the eastern margin of the New Jersey area, which is sharply defined along the western bank of the Hudson from Jersey City northward to Stony Point, these indications of shore conditions are entirely lacking, in their stead there are sandstones, slates and shales of the character of ordinary off-shore deposits. The trap rock forming the Palisades will be noticed farther on.

Crossing to the Connecticut valley we find this order reversed; on the eastern margin of this area the coarse conglomerates again occur, together with an abundance of all the other proofs of shore conditions we have mentioned; on the western margin the rocks have been formed of sand and mud deposited at a distance from the shore, and are without sun cracks, footprints, etc.; these beds correspond with the sedimentary rocks in the escarpment along the western shore of the Hudson. From these facts it seems perfectly justifiable to conclude that the variegated conglomerate bordering the New Jersey area on the west, corresponds in character and position with the coarse conglomerate occurring along the eastern margin of the Connecticut River region, thus mapping out portions of the eastern and western shores of the estuary in which the Triassic rocks were deposited.

Thirdly. The occurrence of an outlying mass of Triassic beds in the towns of Southburg and Woodbury, Conn., lying between the two great areas, also favors the conclusion that the sandstones and shales of New Jersey and the Connecticut valley were once united. This little oasis in the valley of the Housatonic, is but six or seven miles long by two broad, and is separated from the Connecticut valley area by fifteen and from the Hudson by forty miles of crystalline rock.[1]

Fourthly. The topographical features along the western margin of the New Jersey area and the extension across the Hudson of the line of bluffs which border the formation in New Jersey, as stated on page 21 of the writer's previous essay (page 241 of the Annals), also indicates that the Triassic rocks of New Jersey at one time followed the course of this old shore line and extended eastward of the Hudson.

Fifthly. The striking analogy that exists in the arrangement of the hills of trap found in these Triassic areas was also pointed out in the paper mentioned above. Nearly all the igneous rocks found in New Jersey and the Connecticut valley have been formed as sheets of molten matter intruded between the layers of sedimentary rock and have cooled and crystallized in that position. In the Connecticut valley these sheets of trap dip eastward at the same angle with the sandstones and shales, and present a bold escarpment to the westward; the ends of the long ridges are

[1] Percival's Geo. Rep. of Conn., 1842, p. 410. Also Annals of N. Y. Acad. of Sci., Vol. 1, No. 8 (1878), p. 240.

usually bent eastward so as to give them a "canoe-shape." In New Jersey the sheets of trap are inclined to the westward at an average angle of about fifteen degrees, and present their mural faces to the eastward, as in the Palisades along the Hudson. The trap ridges in New Jersey are also canoe-shaped, but have the ends bent to the westward.

From the study of these trap sheets we may derive important conclusions in reference to the former thickness and extent of the sedimentary rocks with which they are associated. We have previously shown that the long mountain-like ridges giving variety to the landscape in the Triassic areas of New Jersey and the Connecticut valley, are the outcropping edges of sheets of trap that have altered and metamorphosed the stratified rocks both above and below them.[1] From the slope which these outcropping sheets still show—to the westward in New Jersey and eastward in the New England area—it is evident that they were at one time inclosed in sedimentary strata, which have since been eroded away. That these sheets of trap did not reach the surface of the sedimentary beds is also evident from the fact that the molten material did not overflow and form table-lands, like those so common in New Mexico and other portions of the far West. On the First mountain, at Plainfield, New Jersey, as exposed along the Johnston drive, the baked and altered shale is still to be seen on the top of the trap ridge, three hundred feet above the general level of the surrounding plain; here we know that the trap ridge was entirely inclosed in beds of shale and sandstone, and at the very least three hundred feet of sedimentary beds have been removed by denudation. Extending the same reasoning to the Palisade range, we find that it too is a sheet of trap that cooled between strata of shale and sandstone; this conclusion is also borne out by the nature of the trap forming the Palisade range, which is dense and compact, showing that it cooled under pressure. This ridge of trap presents a continuous outcrop from Bergen Point, where it is but a few feet above tide water, northward to Haverstraw, when it attains an elevation of over a thousand feet. Are we not safe in concluding from this evidence that the sedimentary beds were once more than a thousand feet thick along the western bank of the Hudson, and that these same

[1] On the Intrusive Nature of the Triassic Trap sheets of New Jersey. Amer. Jour. Sci., Vol. xv, April, 1878.

strata must have extended on to the eastward? Opposite New York city fully three hundred feet of sandstone and slate is exposed beneath the trap, their broken edges forming the shore of the Hudson at Weehawken. It is to be remembered in this connection also, that these beds were off-shore deposits and had an inclination of fifteen degrees to the westward.

Sixthly. If we could arrive at definite results in reference to the present rate of erosion of the Triassic rocks, we could form more accurate conclusions as to the former thickness of this formation. We know, however, that the present waste, although the rocks are but little elevated above the sea, is very rapid. Composed of soft shale and sandstone, and highly inclined, these rocks present the most favorable conditions for rapid erosion; if these rocks have been exposed to subaerial denudation for a long time, it follows that an immense amount of material must have been removed.

The present drainage of the country shows that the upheaval of the Triassic beds was extremely gradual, and hence that they have been exposed to denudation for ages. The Delaware, for instance, flows at right angles to the strike of the rocks, and has carved out a broad *anticlinal* valley, about thirty miles in length, through the shales, sandstone and trap sheets of the Triassic. From this we must conclude that the Delaware flowed eastward through this region before the rocks were upheaved, and that the elevation of the beds went on so slowly that the river was enabled to cut out its channel as fast as the rocks were brought within its reach. The Susquehanna, the Potomac and other rivers to the south, also bear evidence to the slowness with which the Triassic rocks were elevated, and consequently to the great lapse of time during which they were exposed to subaerial erosion. The deep cañon-like valley of the Hudson, now partially filled, bears evidence of the same nature. No one who does not believe that the surface of the earth has always been as we see it to-day, can resist the conclusion that the Triassic rocks must at one time have had a very great thickness. The problem of measuring the former extent and thickness of the Triassic rocks in feet is far from being determined; we can only conclude from the above considerations, as the time has been long and the rate of erosion rapid, that their former thickness must have been very great.

The material removed from the region separating the two Tri-

assic areas under discussion, must have been composed of sandstone, slate and shale like the escarpments bordering the denuded area on either side, but did not include beds of trap, for as we have already shown the trap ridges are intrusive sheets derived from fissures in the crystalline rocks beneath the regions where they occur.

In my previous essay the statement is made that if faults do not exist in the Triassic beds of New Jersey, that we cannot reckon their thickness at less than 25,000 feet. Under the same supposition the Triassic formation in Pennsylvania have been calculated to be 51,500 feet thick. In the notice of my paper which appeared in the *American Journal of Science*,[1] the first three objections to my conclusions are based on the misconception of this statement. As to the fourth objection, that the "northern limit of the Connecticut valley sandstone area is *north of the northern* limit of the New Jersey. The New Jersey area cannot, therefore, be on the opposite margin of the sandstone region to that of the Connecticut valley," the fact is overlooked that the relative position of these two areas has been determined by the direction of the axis of upheaval of the central region and by the accidents of erosion. Were the Triassic rocks in New Jersey entirely removed, those found to the southward, in Pennsylvania and Virginia, would still be portions of the western margin of the deposit, opposite to that found in the Connecticut valley.

In objection number five of the review, the sweeping statement is made that "no evidence of such an anticlinal, or of the supposed amount of erosion, exists excepting this—that the sandstone of the Connecticut valley dip eastward, and that of New Jersey, situated wholly to the south of the southern limit of the Connecticut valley area, dip northwestward, at the angle stated." The only reply that can be made to this, is simply to refer to the remaining lines of evidence converging on the same point.

It is puzzling to know how "violent floods of the Connecticut river, enlarged for a part of the time by the waters and ice of a semi-glacial era" could spread out wedge-shaped masses of coarse conglomerate along the eastern margin of the Triassic formation, the material forming the conglomerate being clearly derived from the shores of crystalline rock against which the bases of these wedge-shaped masses rest. As we go westward from the old

[1] *Amer. Jour. Sci.*, April, 1879, pp. 328–330.

shore line these beds of conglomerate thin out and pass into the finer off-shore deposits; associated with the conglomerate we also find an abundance of footprints, rain-drop impressions, etc. On the western margin of the same area these proofs of shore conditions are wanting. If this is a river, or a narrow estuary deposit we should expect to find somewhat similar strata on each side of the valley, and that the material forming the rocks should become coarser as we go northward, which as the geological surveys show is not the case; then, too, what river with floods and ice-rafts spread out the Triassic beds in New Jersey, which extend in one unbroken area far into Virginia, with the same structural peculiarities as are found in the Connecticut valley but reversed in their relative position.

Since my essay on the Physical History of the Triassic Formation was written, an interesting and valuable paper on the "Mesozoic Formation of Virginia"[1] has been published by M. O. J. Heinrich, in which many facts are given that have a direct bearing on the question of the former extent of the Triassic formation. The map accompanying this essay gives the position of the detached areas of Triassic rocks in Virginia and North Carolina, together with the dip of the beds, and suggests very strongly that the separate patches were once united. This conclusion presented itself to Mr. Heinrich also, as on page 23 of his paper we read, "the destruction of a connection formerly existing between all the Mesozoic deposits along the Atlantic States might, therefore, be attributed to a slow, an unequal rising of the Eozoic rocks after the deposition of the former upon the uneven floor of the latter, noticed in the anticlinal of the latter, and producing an unequal denudation of the Mesozoic deposits." In the carefully-prepared section of the Richmond coal basin, published with this paper, we find a rapidly-alternating series of sandstones, shales and coal, 1518 feet thick, including a coarse conglomerate thirty-six feet thick at the bottom of the series. This section shows that the conditions at the time of the deposition of these beds was not unlike those now prevailing at the northern end of the Bay of Fundy, where the Tantra marshes are forming.

Another paper on the "Mesozoic of Virginia," by Prof. Wm. M. Fontaine, published in the *American Journal of Science* about a year since,[2] contains much interesting and valuable matter, but

[1] Tran-actions Amer. Inst. Mining Engineers, 1878.

[2] *Amer. Jour. Sci.*, January, 1879.

arrives at conclusions in reference to the formation of the Triassic conglomerates, the climate of the Triassic period, etc., that seem at variance with the facts, at least as presented in the northern areas of Triassic rocks. The conclusion that the conglomerates are of glacial origin, as also suggested by Prof. Dana,[1] is not sustained by the structure of the variegated conglomerate in New Jersey.

The view that the Appalachian Mountain region was of sufficient height to become covered with perpetual snow, and give rise to glaciers which terminated in the sea, and brought down as moraines the material forming the Triassic conglomerates, and also that the paucity of animal remains in the Triassic rocks is due to the low temperature of the water, owing to the supposition that "the Mesozoic area was fed by the cold waters issuing from the ice and snow of the mountains," is open to several serious objections:

First. The conglomerate, at least in New Jersey and the Connecticut valley, is of the nature of an ordinary shore deposit, formed mostly at the mouths of streams.

Second. The boulders in this conglomerate are smoothed and rounded, but do not show grooves, scratches or planed surfaces like the stones to be found in a moraine.

Thirdly. The fossil plants occurring in these rocks are ferns, cycads, equiseta and coniferous trees of the Araucarian family, these are found from North Carolina northward at least as far as Connecticut and Massachusetts; the home at the present day of the plants belonging to these families, especially of the Cycads and Araucarias, is in tropical and sub-tropical regions.

Fourthly. There was an abundance of reptilian life in Triassic times, as is shown by the great number of footprints found both in New Jersey and the Connecticut valley; reptiles of large size also lived as far northward as the Prince Edward islands. All the larger reptiles of the present day are confined to the warmer regions of the globe, and are mostly found within the tropics. We can hardly believe that the gigantic reptiles of the Triassic age were so different in habits from their modern representatives that they could find a congenial home along shores that were covered with ice, or in waters derived from the melting of glaciers in which icebergs were floating.

[1] *Amer. Jour. Sci.*, April, 1879, p. 330.

The absence in the Triassic rocks of the peculiar markings that are made in soft mud when it freezes, and which are as capable of being preserved as are rain-drop impressions or footprints, is another although a negative indication that there was a mild climate in the Eastern States during the Triassic period.

Then, too, there was not a "paucity of animal life" in Triassic days, as thousands of footprints show; the waters of the estuary were also inhabited by immense numbers of fishes, some of them of considerable size. As to the absence of molluscan life owing to the coldness of the waters, we know that many species of Arctic shells are found in the mud at the foot of the glaciers that terminate in the sea in high latitudes, and that the same and allied species are found in the glacial clays both of Europe and America, thus showing that the presence of ice could not account for the absence of molluscan remains in the Triassic formation. The absence of shells in these rocks seems due to the fact, long since pointed out by Sir H. De la Beche,[1] that animals which live on the sea bottom cannot exist upon a bottom of red mud, and that the presence of peroxide of iron in the waters is fatal to animal life; the presence of peroxide of iron in the rocks will also promote the rapid decomposition of such organic remains as may become imbedded in them. All who have wandered along the shores of the Bay of Fundy, where the bottom is composed of red mud, will remember how destitute they are in mollusks, radiates and crustaceans, the waters are inhabited, however, by great numbers of fishes, belonging, I believe, to a limited number of species. Thus in almost every particular, the study of the present condition of the Bay of Fundy furnishes us with the key with which to unlock the history of the Triassic formation.

The information added by the papers of Mr. Heinrich and Prof. Fontaine, tends to confirm the conclusion that the Triassic rocks in the Atlantic States were formed in one estuary, in the northern end of which sandstone and shales were deposited, being subjected to a greater subsidence than the southern extremity, where the shores were low and favorable for the accumulation of carbonaceous mud and peat.

As the determination of the age of the rocks in question from the fossil plants they contain, has led to widely varying results,

[1] Memoirs of the Geological Survey of Great Britain, Vol. I, p. 51.

we have continued to call them Triassic. If the view here presented of their former extent is sustained, it is evident that the separate members are of one age, differing in their lithology and fossils according to the various conditions under which they were deposited.

NOTE.—Although the conclusions given in my former paper were arrived at independently, I find that the same explanation of the dip of the rocks has presented itself to others. Prof. Hitchcock in his work on the "Ichnology of Massachusetts," p. 14, in speaking of the opposite dip of the beds in New Jersey and the Connecticut valley, says, "It looks rather as if an anticlinal axis or elevation between them, had been concerned in the tilting of both." Prof. Kerr, in his report on the geology of North Carolina, page 141, accounts for the separation of the Deep and Dan river Triassic areas by the upheaval of the region lying between, and the removal of the Triassic beds by denudation, the parts remaining are the fringing portions of a great anticlinal. Prof. Bradley, in an article "On the Geological Chart of the United States east of the Rocky mountains" (*Amer. Jour. Sci.*, Vol. XII, p. 289), favors Prof. Kerr's conclusion and suggests that the numerous trap dikes intersecting the metamorphic rocks of North Carolina, South Carolina, Georgia and Alabama, may belong to the Triassic series and indicate the former extension of this formation southward; the dip of the beds in New Jersey and the Connecticut valley also attracted his attention and suggested the former connection of these two areas.

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NOTES ON STONE IMPLEMENTS FOUND IN NEW JERSEY.

BY CHAS. C. ABBOTT, M.D.

THE recent article by Prof. Perkins in the January NATURALIST[1] suggests the propriety of my making a brief reference to certain forms of stone implements which have been found in New Jersey since the date of the publication of the Smithsonian Annual Report for 1875;[2] and particularly to the occurrence of such

[1] Archæology of the Champlain valley. By Prof. Geo. H. Perkins.

[2] January, 1877. It may be well to state that the MSS. of my paper was completed in Dec., 1873, and during the six years ensuing, I have gathered fully twelve thousand additional specimens. None of these are referred to in the Smithsonian Report for 1875.

as are identical with those found in Vermont, and which are supposed to be of other than "Red-skin" origin. Prominent among these are the stone tubes. The best New Jersey examples are those from near Bridgeport, Gloucester county, N. J. They are made of a drab-colored clay slate, about one inch in exterior diameter, and ten inches in length. The finish in all respects is excellent, and in every feature are they identical with those described by Prof. Perkins. These New Jersey specimens are in the cabinet of Mr. Wm. S. Vaux, of Philadelphia. Smaller examples of variegated green slate, and others of baked clay[1] have been found by the writer, but none so long or so elaborately wrought as the Bridgeport specimens referred to. Excepting such as have the perforation of very small diameter, these tubes do not differ materially from the California tubular smoking pipes.[2] Curiously enough, associated with these Bridgeport implements were found some magnificently wrought chalcedony spear-heads, remarkably similar to California specimens found in the same graves as the tubular pipes referred to. (See Plate II of Archæology of Wheeler's Survey, Vol. VII.) Interesting as the occurrence of supposed relics of the Mound-builders in Vermont certainly is, it is of greater wonderment that the California types should occur as far distant as the Atlantic coast; unless indeed there is or was a very close connection between the several peoples of the continent. This, it seems to the writer, is highly improbable. So far as the New Jersey examples of stone implements and ornaments of extra-limital forms are concerned, the writer is disposed to refer them to the Shawnees, who at one time occupied much of the valley of the Delaware, and coming from the south-west either brought them from the neighborhoods of their distant homes, the products of their own handiwork, or were at that time even, veritable relics of a forgotten people. Whether the Shawnees were mound builders or not, need not here be discussed. Sufficient to know that they may be located wherever one finds the mounds, and so it would not be strange that they should copy and also preserve the relics of this supposed "pre-Indian" people.

[1] *Nature*, Vol. XIV, p. 154, Figs. 3, 4 and 5.

[2] U. S. Geog. Survey west 100th meridian: Vol. VII, Archæology, plates VII, VIII, IX. The sixteen smoking pipes here figured are not cylindrical like the Vermont and New Jersey examples, but are so far similar as to suggest identical purposes. One tube of uniform caliber I have figured and referred to as a "medicine tube," in another chapter. See the volume.

Prof. Perkins refers to the comparative rarity of grooved axes in the Champlain valley. So far as I can ascertain, they are not plentiful anywhere throughout New England, while in New Jersey and southward they are exceedingly abundant. During the years 1878 and 1879, I gathered nearly two hundred, and have certainly seen at least one thousand in the various private collections I have studied. So numerous are these stone axes in New Jersey, that I think it within bounds to estimate one to every five hundred acres of the State's territory, as ten thousand of these implements are still lying in the ground, and probably half as many more have been already found, and are now in part preserved in public and private collections. As with arrow-points, axes are of every conceivable pattern, and, as yet, no form has been found elsewhere, to the writer's knowledge, that is not represented in New Jersey by one or more specimens. Even the South American form, wherein the groove is reduced to a deep[1] notch on the upper and lower margins, is represented by two specimens found by the writer, and now in the Peabody Museum, Cambridge, Mass.

The remarkable gouge-like implements, on the other hand, are as common to New England as are the axes with us. So dissimilar, however, are the two forms, that it can scarcely be said that the one implement replaces the other. Certainly they could not have had similar uses.

In one respect, the stone implements of Vermont may be said to be superior to those found in New Jersey. This is in the finish and fashioning of the pestles. Pestles with carved heads or any ornamentation are rarely, if ever, found with us. There utility seems to have been wholly aimed at, and, except that some are highly polished, these implements have but little to attract attention. Prof. Perkins refers to the similarity of the Vermont arrow-heads to those of the Southern States, and to a want of likeness to those found in New Jersey. The arrow-heads found here must by no means be judged by those I have figured in the Smithsonian Report. Since the issue of that volume, thousands of more delicate workmanship, and a score of other shapes have been gathered; and I hope ere long to give figures of all these, and also of every pattern of stone implement, ornament or weapon found within the limits of the State.

[1] Archivos do Mus. Nacion. do Rio de Janeiro, Vol. I, Estampa 1, Fig. 2. Rio, 1876.

SOME NOTEWORTHY BIRDS.

BY SAMUEL LOCKWOOD, PH.D.

THAT was a memorable event in the annals of bird lore when those Arctic owls made their remarkable raid upon us in our centennial year. What it was that induced *Nyctea nivea* to make that visit in such numbers after the big show was closed, and the world's folk had left, may be a question. Probably the commissariat was under consideration; in which case our snowy owl had grave reasons for his coming. Winter is hardly a prime season for delicacies in the larval line, and the construction may seem awkward, yet it will bear assertion that these birds of Pallas were after grub. Though bold, Nyctea did not put on style. It was simply that sort of personal bearing which comes of innocence. In the Northern cities he even perched on chimney tops, and in rural places was familiar with men, even unto rashness. Our farmer friend, his family filling the large carry-all wagon, was on his way to church, when lo! by the road side, "a sitting on a rail," was one of these Arctic owls. No man is himself at all times, and our good friend's piety was sorely tried, for the strange bird actually ogled at him with its big brass-button eyes. He would have railed at the bird. He was on the fence what to do. It is Sunday. Shall he send Thomas back for the gun? The wife suggests they'll be late to meetin'. The bird owes his life to that good woman. In the markets of New York these owls were suspended in strings like poultry. Upon inquiry, Terence was told that they were Spanish geese. "Sure then, for a goose, it has an uncommon knowing face." To many a village "bird-stuffer" in the Eastern States, that winter of '76 brought a large increase of business. In not a few parlors of my acquaintance, a snowy owl became a fixture, and was pointed to as an avian prize. But our splendid bird has become unable to uphold its reputation. The tidy housewife charges it with bringing in that tiny reprobate, the clothes moth, *Tinea flavifrontella*, it of the yellow face, which after plucking Nivea in spots, finishes on the rep upholstery. A young friend captured one of these Arctic raiders alive. So long as he was well supplied with mice, the bird was quite good natured, and even submitted to the caresses of his master; but the young man found the demands of that hungry maw very exacting; in fact that owlish stomach was too

capacious for him to fill, so he killed the bird in order to have it stuffed.

The winter of 1877 brought to the coast of New Jersey an unusual number of the Arctic dovekies, *Mergulus alle*. I was much interested with these queer but amiable little fellows. I held the idea that in their high northern range, they even visit the Pole, thus putting to blush our efforts in that direction. A boy on his way to school saw a bird acting very strangely by the side of a small stream. It was six miles from the sea, and entirely beyond tidal reach. The boy captured it, a simple matter, as he had only to go and pick it up. He took it to school, where the heat and dryness occasioned it much suffering, while its odd appearance and singular action caused much amusement. It stood so bolt upright that the scholars said the bird stood on its tail. When the lad got home a tub of water was procured, and then came the fun. The bird seemed crazed with delight. It ducked and dove and splashed. Then it would make a dash, fetching up against the side of the tub in a manner not altogether "healthy;" but then Mergulus is not the only biped that takes a winter tub in an injudicious way. I had furnished the local editor a paragraph in which was given the systematic name of the bird. Another specimen was found in a neighboring village, standing on the wood-pile in the back yard of a house, also some distance from salt water. It was mounted by the local taxidermist, who ambitiously named it from the newspaper paragraph. It found its way to the bar-room of the tavern, where I saw it, and was told its name by the obliging landlord, who said that he got it from the bird-stuffer, who told him that it was scientific. "Ah, indeed! Could you tell me what it means?" "Oh, yes! Our doctor says *Mergulus alle* means all-sea-gull." It would have been neither courtesy nor policy for me to say that mine host and the doctor were gulls all over.

I am at a loss to conceive why these birds, so thoroughly marine in their nature, come so far inland. Flight must be very laborious to them, and every motion on the land is awkward to a degree. But in the water, all is truly wonderful—there the bird displays grace, speed and a certain refinement of motion. There is much to wonder at and to admire in the sea dove's ways when in her own element. Just stand with us on the bluff at Long Branch. There is a high swell, for the wind is pretty stiff and

directly from the sea. We shiver in this wintry gale. How crushingly the surf comes rolling up the strand. What grand high waves they are—and to what a solemn cadence is the whole movement made. There are several sea doves, to whom all this is blissful and delicious. When it suits they can ride the crest like the stormy petrel. But see that gorgeous wave approaching, and that sea dove goes right through it, as an arrow shot through a cloud of smoke; and the bird comes out into the deep trough beyond, and with every feather dry. And now it scoons along the green glassy bed of that aqueous valley, then up the round side of that great water mountain which it has just pierced, then it sits like a little puff on the advancing crest. These are the nice points in the high art of natatory locomotion. It can float like a bubble and progress like a shot, while its rapid sub-aqueous movement, as against the momentum of the incoming wave, calls out one's admiration. And what about the molecular thrill of that tiny avian brain? You may depend there is high glee there. Forward it comes, borne on that great surf-wave, which now strikes the shingly beach and breaks up into wild seething froth. The little bird, like a dark spot, ascends the sloping shore so quietly riding on the mad, white foam. Its grand role, however, is over. It suffers itself to be left high up on the beach by the scattered, receding surf. The shore seems alive with sand fleas, and *Orchestia agilis* is a dainty shrimp-like bait for our sea dove. The bird appreciates the opportunity, and sets itself to make the most of it. But oh, how awkward! But then, how is a body to put one's best foot forward when both *pcs* are set so extremely far backward? So its every effort to capture Orchestia on dry land is decidedly inartistic. As if to save it from damaging so fine a record, my pupil's shaggy white retriever walks quietly up to the bird, takes it in his mouth, and carries it to his master. "Ah, Whitie! you have nipped birdie a little too hard, and Dovekie has come to grief."

In November, 1878, my friend the railroad conductor called on me. He had with him a box obtained at the grocery, which, with laths nailed on one side, he had improvised into a bird cage. The cage was carried by a boy whom he ordered to set it on my study floor, which done he thus made known his errand:

"Professor, here's a queer bird which we caught on the beach at Manasquan. I went up to it, and was surprised that it did not

fly away. Nobody knows what it is, neither the fishermen nor the old gunners along the coast. They all say that it is a tropical bird, and the most of us think it has been a pet on some vessel inward bound, and that it somehow got overboard and had to work its way to land. So I have come to see if you can tell us what it is. Now then, Pet, come out and show yourself to the gentleman." Having thus delivered himself with the same preciseness as when calling out the stations for his passengers, the conductor pulled up a few of the slats, and sure enough, the pet did come out and show himself. He had a body about as big as a pigeon's, with long legs and long toes. I had never seen his like. But there were certain features so noticeable, that with "Coues' Key to North American Birds," the merest tyro could soon determine the genealogy of the stranger. The bill was pinkish-red, and as Patrick might have remarked—"The cratur carried a breast-plate on the front of his head; and though with never a stocking to its name, it wore red garters on its legs." The bird had on its forehead a flat smooth plate like red coral, or sealing-wax, giving it a somewhat cooty aspect; and around each tibia was a red band, as if a fillet of the outer skin had been removed. It was the Florida Gallinule, *Gallinula galeata*. There was no strut in its walk. But for the occasional slipping of those great splay feet on the smooth oil cloth, the bird sustained a self-possession, with a dignity of carriage which was charming to witness. I called in my family to see the interesting stranger. Their entrance in no wise disconcerted Gallinule, although Madam stroked him on the back and patted him on his head, and even felt of his helmet plate. He was evidently a person not to be injured by flattery. Although undesigned, there seemed to me genuine humor in the contrast of the running down of an insect on the lily pads of a Florida pond and that stately megalopodian tread on my study floor. But for our confiding nature we should have suspected the stranger of putting on uprightness, an instance of mimicry of that good old knight, Sir John Auricular, who in all God's ways walked perpendicular. I came near asking, "Where did the bird get so much good breeding?" but was interrupted by the conductor, who reiterated his theory as sufficient for the facts: "You see, Professor, how tame he is, and gentle. He doesn't mind anybody. It's that which makes us believe he is a pet off some ship." "I don't think so; though for all that

it is barely possible that he may have been on a ship; for he has a gay cousin down south, the purple Gallinule *(Porphyrio martinica)*, who has been known to board a vessel two or three hundred miles out at sea." We set to work to search the house for flies, the whole family going at it with zest. Here again the bird awoke our interest. With no flurry, but in a quiet and most sensible manner, he would approach the person bringing a fly, and take it gently, in such a knowing way, from between the thumb and finger. I was much impressed with the belief that scent had much to do with the matter, as the insect was so held that it could not be seen.

Again the conductor suggested his theory to explain the fact: "You may depend, Professor, he's a tame bird, and is used to being fed from the hand." We had a theory, too, but which we did not broach, to wit: that it was a specimen of extra good bird sense, actuated by the keen demands of appetite. But it was so late in the fall that the flies were quite scarce, and we could not find one more. We then tendered him cake and bread crumbs, to which he took very gingerly, evidently not hankering after such rations. Some fresh water was set before him, of which he took a pretty good drink; after this, entirely of his own option and in a very quiet way, he went to his cage, entered, and squatted on its floor, and in its own dumb way seemed to say to its owner, "Please, sir, now shut the door." Bidding the boy who was with him to carry the box, the conductor and his singular pet left. Thus cooped up, with not a vestige of its natural environment, either as to food or water, in two days the poor bird died. I saw it not long after, a mounted specimen in the bird-stuffer's shop. But now the red garters had faded into a foxy hue. So too had the rosy bill. As for that quaint frontlet of polished red coral, it had lost both color and form, for it had shriveled up into an unsightly rosiny scar.

Such are a few memory notes of life features on the human side, of some of our rare New Jersey birds.

ON THE MICROSCOPIC CRYSTALS CONTAINED IN PLANTS.

BY W. K. HIGLEY.

IT has been the custom to call all crystals that occur in plants, whether in the cell contents, the cell-wall or even the non-microscopic crystals that are found in the outer portions of plants, by the common name "raphides," no matter what the form may be. And while giving this general name to their form, a much more general chemical composition was given, viz: oxalate of lime; and for a long time they were all supposed to have had this composition, and even up to the present day many writers have considered them thus. The decision of some seems to have been based on the analysis of the inorganic matter of one crystal-bearing plant, which proved to have the above composition, and in drawing their conclusions they considered that all crystals of apparently the same crystalline form, were of the same composition. But it is difficult to tell, at all times, the exact crystalline form, as different forms sometimes resemble each other very much. And as the form may vary, so may the chemical composition. Crystals of some form seem to be nearly or quite universal; on close examination they may be found in some part or parts of the majority of plants. In some plants they are only found in a certain position and of one form, while in others they may occupy several localities of the plant, and have as many forms. But the position and form often vary so much that it has been recommended by some authorities that they be made a family, and in some cases a generic distinction in the study of systematic botany.

Prof. Geo. Gulliver, while making dissections under the microscope for the purpose of comparing the relations between the structure of plants and animals, made note of every case, in the examination of plants where raphides or other crystals occurred, and he says: "It was not before a large accumulation of my notes had been examined that crystals were thought of in this point of view; for they had not even been particularly looked after, and were merely noted whenever seen, long before their significance as characters were suspected. But when every one of these notes on raphides had been picked out, it was very unexpectedly discovered that the plants in which they occurred would sometimes come under certain orderly arrangements.

Thus not a single species belonging to the order Onagraceæ or Galiaceæ was without a note of raphides, while in no single instance were these acicular crystals noted in the next allied orders." A converse example is then given. He then proves by more extended experiments that raphis-bearing is essential throughout the lives of certain species. By this and other experiments that I might mention, it is shown that the form and position of microscopical crystals in plants may be used as a distinctive character between orders especially, and perhaps to a certain extent, between genera and species (?). Plant crystals as a character would only be of benefit to the botanist who had at hand a microscope that magnified at least a hundred and twenty-five diameters. Hence the objection to making them a means of identifying plants in our works on systematic botany.

As to the history of crystals, Lindley states that they were first seen by Rafn, who found them in the milky juice of some species of the family Euphorbiaceæ, and that they were afterwards seen by Jurine in the leaves of *Leucoium vernum* and elsewhere.

Edwin Lankester, M.D., writing on raphides, credits Malpighi with the discovery of crystals in plants, who found them in a species of Opuntia, and he says, further, that they were afterwards described by Rafn as occurring in the milky juice (latex) of some plants belonging to the family Euphorbiacæ, and that Jurine soon after found them in the leaves of *Leucoium vernum* as stated by Lindley.

Raspail seems to have been the first person who studied crystals with their chemistry in view, at least he was probably the first to demonstrate that some of the crystals were composed of calcic oxalate.

John Quekett, in a paper written in or about the year 1852, also gives the credit of the discovery to Malpighi, and says that they were subsequently described by Jurine and Raspail, as stated above.

Prof. Gulliver says that the raphides so early mentioned by Rafn in the Euphorbiaceæ were only the starch-rods which he (Gulliver) described as having found in the latex of the British Spurges.

Crystals should be divided into (at least) three classes and these seem to cover all the ground that was formerly covered by the name "Raphides." They are as follows:

1. Raphides.
2. Sphæraphides.
3. Crystal prisms.

1. *Raphides.*—The term raphid is from the Greek ῥαφίς, a needle, and was formerly applied by De Candolle to crystals resembling a needle in form.

Prof. Gulliver gives the following definition of the term: "These are slender needle-like crystals with rounded, smooth shafts, vanishing at each end to a point, from about ten to fifty or more lying parallel together so as to form a bundle, which partially fills a cell or intercellular space."

I have never been able to find over thirty in one cell, and generally from five to twenty-five. The cells which contain them are generally elongate, or quite oval. To obtain these crystals in a bundle and still have a thin section fit for microscopical work, a steady hand and great care are required, as they are easily disturbed, when they will be seen scattered in every direction. Often on slight pressure they are seen to escape, one by one, quickly from one or both ends of the cell. When this occurs they are then known as "Biforines." The bundle of crystals is very loose and might be compared to a bundle of needles.

The genus *Trillium* affords a good example for the investigation of these crystals, and still better the species of the family *Araceæ*, with one exception which will be mentioned soon. In this family the raphides are found in great abundance and are about the largest that I have seen. As the plants of this order are very common, any one may examine them at pleasure. They may be found in any part but are best seen in the stem.

2. *Sphæraphides.*—This word is from the Greek σφαῖρα, a sphere or globe, and ῥαφίς, a needle or pin. "They are more or less rounded forms made up of a congeries of crystals, many of which are prisms, often acicular." As they often have points extending in all directions from the main body of the crystal, they appear rough and frequently stellate; they are generally found regularly placed, one imbedded in the substance of each cell. A collection of cells containing these crystals is known as a "sphæraphid tissue."

The flower parts of the geranium serve as a good field for observing them. These crystals are very common and are found in connection with raphides in the family Vitaceæ. But the best place to examine them is in the family Cactaceæ. These crystals as well as the next class were formerly known, incorrectly, under the common name "Raphides."

3. *Crystal prisms.*—These are "acicular forms with well-marked faces and angles both on the shafts and tips." They are found imbedded in the tissue of the plant and are never seen in bundles or loosely packed together, or single in a cell or intercellular passage. I have found as many as five of these crystals imbedded close together in certain tissues, but generally only one. They vary much in size but are generally much larger than raphides from which they may be easily distinguished. The family Compositæ furnish about the best field for the examination of this class of crystals, but they are much less common than the other forms of crystals.

My own observations and experiments have been, at present, mostly confined to the natural orders Araceæ, Vitaceæ and Compositæ. I examined the first two orders especially, as they abounded in crystals, and this gave me a better opportunity to examine into their chemical composition with more sure and satisfactory results.

In examining each specimen for the composition of the crystals, I first made the test under the microscope as far as possible, and in the case of inorganic crystals incinerated the substance and analyzed the residue. Of course from this analysis it is not possible to state the exact composition of the crystals, whether they are, for example, acid or neutral salts; but we are able to state with certainty what the elements are that enter into the crystal. And at times and under certain conditions, and also by analogy, the exact composition may be ascertained; for example, if on examining the tissues of a plant octahedrons are found, and if under the microscope they do not effervesce with acetic acid, but do with stronger acids, and if after incineration we find on analysis calcium and carbonic acid, we may conclude with certainty that these crystals are composed of calcic oxalate. However, other acids than the one just mentioned do occur, as phosphoric and carbonic acids; the former I tested for under the microscope in the following manner: obtaining as large a field as possible of the crystals, I added a drop of hydrochloric acid and heated the slide slightly and then added a small amount of molybdate of ammonia; heating the slide again and allowing it to stand for some time, I placed it under the microscope, when, if any phosphoric acid was present the characteristic crystals of phospho-molybdate of ammonia would appear. These crystals

are stellate forms consisting of four or six points, and have a yellow color. *This test requires care, as too much heat seems to dispel the crystals.*

The latter (carbonic) acid I detected in the usual manner with acetic acid.

The three acids mentioned above are the only ones that I found. Dr. Gray, in his "Structural and Physiological Botany," page 60, reports sulphuric acid.

The tests applied for the base were the same as those given in Douglas and Prescott's "Qualitative Analysis," but the only base found was calcium. The methods of testing given above were followed in nearly all cases. Where there is any change it will be mentioned in its proper place.

I will now give the results of my own work, commencing with the order Araceæ; in this order the raphides are abundant and large, and the cells that contain them are much elongated. The bundles contained from ten to twenty-eight crystals. The number was noted in twenty specimens and the average, twenty-five, taken from the results. Raphides were found in all parts of the plant *Arisæma triphyllum*; they varied some in size, but were, on the average, about $\frac{1}{100}$th of an inch long and $\frac{1}{10000}$th in diameter. The raphis-cells were very large and elongated and easily distinguished from the surrounding cells.

Dracontium, another species of the same genus as the above, showed no material difference in the position, size and number of the crystals from the first species.

In *Symplocarpus fœtidus*, or skunk's cabbage, the crystals were as common as in Arisæma, but were, on the whole, somewhat larger, and were found, as in the above species, throughout the plant. The raphis-cells of this plant were about $\frac{1}{80}$th of an inch in length and $\frac{1}{1000}$th in diameter. Some of the crystals appeared to be biforines, which I did not observe to be the case in any other species of this order. Thus if the odor of this plant can be overcome, it furnishes a good field for work upon this subject.

In *Acorus calamus*, or sweet flag, I was not able to find a single raphid, and as far as I am able to find articles upon the crystals of this family, none have ever been reported, but time and again students have been disappointed in not finding them. This genus is thus marked off from the rest of this family, although agreeing with the family characters perfectly in other particulars. Dr.

Gray, in his systematic arrangement of plants, places this genus in the family Araceæ, but Lindley, on account of there being no raphides, and as the general characters of the plant would not permit of its being placed in any other family, places it in a family by itself, calling it Acoraceæ. This genus contains but few crystals of any sort. On examining a number of specimens I found only a few crystal prisms, which effervesced and dissolved with hydrochloric acid and were probably oxalate of lime. With the exception of the genus Acorus the crystals mentioned in this family showed with certainty that they were composed of phosphate of lime when the chemical tests were applied both under the microscope and also to the incinerated residue.

[*To be continued.*]

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EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

—— The late meeting of the American Association for the Advancement of Science at Boston, under the presidency of the Hon. L. H. Morgan, was a very successful one. There was a large attendance, most sections of the United States and Canada being represented. A considerable number of papers of a high order of merit were read. Propositions for a precise and convenient division of the work of the Association were considered, and a report on the subject may be expected at the next meeting.

The arrangements made by the local committee were excellent, and the most convivial member could not complain of any deficiency of receptions or "lunches," either as to quantity or quality. The excursion to the White mountains was replete with interest to the geologist, the more so as it was accompanied by the State Geologist of New Hampshire, Prof. Hitchcock.

Of the addresses of the officers, we refer to two as especially interesting to our readers, viz: those of Prof. Barker, the retiring president, and of Mr. Agassiz, vice-president in charge of Section B. The former was a general exposition of the present state of knowledge of the physics of life. The chemical nature of the respiratory and digestive functions, and the dynamic characteristics of muscular contraction were passed in review. The character of nervous te'egraphy was discussed, and its relations to mental phenomena considered. The conversion of force in reference

to these acts was set forth in the light of recent investigations, especially those conducted by the aid of the plethysmograph. The identity of conduct of vegetable and animal protoplasm under stimuli and reagents, was regarded as warranting the conclusion that the properties of animal protoplasm have a previous existence in the plant, and that the solution of the vital question in the lowest fungus will solve the problem for the highest vertebrate.

The address then considers the relations of the forces displayed by living bodies to those exhibited by the space-filling ether. In accordance with late usage he discards the term potential energy, and regards the energy of the supposed molecular movements of the ether as representing what was originally intended by that expression. He closes by remarking, "Is it a wonder that out of such a reservoir, the power by which we live should irresistibly rush into the organism and appear as the transmuted energy which we recognize in the phenomena of life?" Further than this speculation can not go, but such language is useful if only as an indication that the field of vital phenomena is not necessarily restricted to our planet or even to our system.[1]

We note here that Prof. Barker has not touched on the question of consciousness in his address, and it might be supposed that he does not regard it as an essential element in the problem. This omission may be explained on the supposition that he does not know what to do with it; for it certainly does not seem to have any appropriate niche in the system of the purely physico-vitalists. For our own part we cannot escape it in considering the evolution of forms; that is as modifying growth nutrition, through molar movements.

Mr. Agassiz's address is an exposition of the palæontological and embryonic histories of the *Echini*, with a discussion of their bearing on the question of evolution. He refers to the early labors of Profs. Agassiz and Vogt on the palæontology and embryology of fishes as the starting point of discussion of the doctrine of parallelism. After a thorough review of the facts, Mr. Agassiz finds the history of the *Echini* to present a conformity to the general law, and that it exhibits, moreover, certain peculiarities. The rule is, that each character taken separately presents an "exact parallelism" between its palæontological and its embryonic histories, but the characters taken collectively, in the combinations which constitute species, do not present such a parallel. In other words, that no extinct species, taken as a whole, is identical with a transitional stage of any recent species. He says, "Any attempt to take up a combination of characters, or a system of combinations, is sure to lead us to indefinite problems far beyond our power to grasp." Here we see the author wrest-

[1] See *Penn Monthly*, 1875, p. 574. AMERICAN NATURALIST, 1879, 420, and 1880, p. 269.

ling with the universal phenomenon of "inexact parallelism," which has received satisfactory explanations at various times,[1]

It is gratifying to find Mr. Agassiz giving a general assent to the doctrine of derivation, but we observe that he cannot forbear intimating that he does not enter the ranks of the evolutionists on account of the society he finds there. He says in effect,—your derivation is probably true, but you can't tell how it was done, so what are you going to do about it? And he proceeds to show that they cannot do anything about it, in the following manner: "The time for genealogical trees has passed; its futility can, perhaps, best be shown by a simple calculation which will point out at a glance what these scientific arboriculturists are attempting. Let us take for instance the ten most characteristic features of the *Echini*. The number of possible combinations which can be produced from them is so great that it would take no less than twenty years, at the rate of one new combination a minute for ten hours a day to pass them in review. * * On the other hand, in spite of the millions of possible combinations which these ten characters may assume when affecting not simply a single combination, but all the combinations which might arise from their extending over several hundred species, we yet find that the combinations which actually exist—those which leave their traces as fossils—fall immensely short of the possible number. We have not more than twenty-three hundred species actually representing for the *Echini* the results of these endless combinations. Is it astonishing therefore that we should fail to discover the sequence of the genera, even if the genera, as is so often the case, represent, as it were, fixed embryonic stages of some sea-urchin of the present day?"

Precisely what relation the above considerations bear to the tracing of the phylogenies, it is difficult to perceive. If Mr. Agassiz had insisted that any or all of the millions of possible combinations he has pictured may have existed as extinct species, he would indeed have presented us with an inextricable genealogical puzzle. But he does not do this, for he admits that the number of the forms which have actually existed is limited. Does Mr. Agassiz mean that there has been no order in this limitation; that there have existed no causes which have rendered some combinations possible and others impossible? Such would appear to be the spirit of his proposition, but it is the objection of a mathematician, and not that of a practical biologist. The chairman of Section B admits that genealogies of single characters may be constructed; therefore genealogies of orders, families and genera can be constructed, for they are, or ought to be (for they ultimately must be), defined by single characters. Having thus established the lines of primary definition, the possible range of variation of the contents of the divisions so defined, is greatly restricted. We can no more anticipate the combination of the characters of two main

[1] See Origin of Genera, 1869, pp. 34-35.

lines of *Echini* after they have been differentiated, than we can expect to find fossil centaurs or sphinxes. So also with the minor lines, though of course the sagacity of the investigator is taxed to ascertain what these are. Thus much in defence of hypothetical lines bridging present gaps in our knowledge. Such have not unfrequently been realized by palæontological discoveries. As to lines already worked out, such as the genera of *Camelidæ*, *Felidæ*, *Rhinocerontidæ*, horses, etc., no question of mathematical probabilities can invalidate the significance of the wonderful closeness of the successive stages which they present.—*E. D. C.*

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RECENT LITERATURE.

NELL'S NEW MAP OF COLORADO.[1]—It is strange that in this country there are no map-makers worthy the name. The only decent maps, either of the whole or portions of the country, are those published by the General Government.

It is sad, but true, that the best map of the United States which can be purchased, and I may add which can be obtained, is published not here but in Germany. This is not from want of skill in drafting and engraving, but it seems to be a want of knowledge, of enterprise and of care in those superintending the work. I am roused to this philippic by the appearance of a map of Colorado, which is a vast improvement, both in style and in correctness of compilation, over anything heretofore published for sale in this country.

The map has been compiled by Mr. Louis Nell, a topographical engineer who has been for a number of years connected with the Survey of the Territories under Capt. G. M. Wheeler. He has brought to the work not only a general knowledge of how a country should be represented on a map, but a personal acquaintanceship with a large part of the country represented. The map shows, too, a degree of painstaking accuracy and care which is very rare among us.

The map is evidently compiled, although authorities are not mentioned in detail, from the work of the surveys under Hayden, Wheeler, King and the General Land Office. The scale of the map is 10.5 miles to one inch. The topography is represented by hachures and by contour-curves at every 1000 feet up to 11,000 feet. The county lines are given, and it may be said, in passing, that the map might have been a little clearer if these lines were less pronounced.

All the later changes due to settlement, roads, railroads, etc., have been added, bringing it fully up to date. The estimated area of irrigable (arable) land is represented by colors. The ele-

[1] *Nell's New Topographical and Township Map of the State of Colorado.* Compiled, from U. S. Government Surveys and other authorities. Washington, D. C., 1880. Scale 10.5 miles to one inch.

vations of many hundreds of points are given in feet above sea level, and to illustrate the careful nature of the work, it may be noted that those measured by spirit-level are distinguished from those dependent upon the barometer.

It is to be hoped, in the interest of map-making in this country, that Mr. Nell may see his way clear to extending his work and making this one of a series.—*H. Gannett.*

HAECKEL'S SYSTEM OF MEDUSÆ.[1]—The early reputation of Haeckel rested mainly on his great work on the Radiolaria, a magnificent and costly folio volume with numerous beautifully executed plates; this was succeeded by his smaller works on the Monera and other invertebrate animals; his great work on sponges then succeeded; in the embryological portion of this work some errors have naturally been detected by subsequent observers. Then Haeckel prepared his popular, more general works, *i. e.*, the General Morphology, his History of Creation and Anthropology. In these works he gave rein to his imagination, and while he attempted to solve problems insoluble in our day and with our present knowledge, and though opening up new lines of investigation, yet committed some extravagances of scientific thought, and in some statements, and especially illustrations from his prolific pencil, overstrained or actually misrepresented nature to suit his own generalizations or ideas. This laid him open to criticism, especially from other observers of eminence, those whom Haeckel had mercilessly and at times coarsely vituperated for what seemed to him blunders and shortcomings, though the charges he made against others have recoiled upon himself. It has been of late a current remark, that Haeckel has lost prestige and that his work upon the whole is not to be depended upon. Hence the scientific public are perhaps taken by surprise at the energy, strength of purpose, industry, accuracy and great skill in delineation shown in the work before us, a work analytical in intention, thoroughly systematic, and which is said by those most competent by long acquaintance with the jelly fishes to judge, to be quite up to the best of Haeckel's systematic and anatomical work. We confess we have a hearty sympathy for those pioneers in biology who, in endeavoring to open up new paths of research, are not afraid to work at times in the dark, and indulge in what prove in some cases to be hasty generalizations, or far-fetched conclusions from too scanty facts. We all forget that Newton emitted several theories which were short lived, and that the best of observers and thinkers sometimes do what proves later to be rash, useless or actually misleading work.

The part before us describes the Craspedote, or naked-eyed

[1] *Das System der Medusen. Erster theil einer Monographie der Medusen.* Von Dr. ERNST HAECKEL. Mit einem Atlas m. 40 plates. Erste hälfte des ersten Theils. System der Craspedoten. 20 Tafeln. Jena, 1879, folio. (Denkschriften der Med. Naturwissenschaftlichen Gesellschaft zu Jena.) Pages 360.

Medusæ, the first legion of the class Medusa. There is no preface or introduction, but the descriptive part opens with a systematic register of the orders, families, genera and species of the legion; then are given the synonymy and characters of the Craspedotæ, of the two sub-legions into which they are divided, then of the orders and minor subdivisions, the definitions being detailed with explanatory remarks. The synonymy and descriptions of the species are fully given, so that the whole is a comprehensive monograph of the naked-eyed Medusæ of the globe; an ambitious undertaking, but one apparently well carried out.

The work is richly illustrated, the large plates being crowded with elegantly drawn figures; they are not so delicate as the illustrations of the Radiolaria, being chromo-lithographs, but are calculated to give some idea of the richness of tints of these beautiful and delicate marine forms; the illustrations are all drawn by the author, and the anatomical details are full and elaborately presented.

The author is anxious to receive specimens of jelly fishes from the Pacific coast for description in the remaining parts of this work, and those who are favorably situated should by all means contribute to the material which will be so well used. From the excellent figures of alcoholic specimens in this work, it is evident that specimens can be preserved and transmitted great distances in spirits.

RECENT BOOKS AND PAMPHLETS.—A sketch of the history of the fossil Vertebrata of India. By R. Lydekker. 8vo, pp. 36, 1880. From the author.

List of the members of the American Philosophical Society. 8vo, pp. 72, 1880. From the society,

Proceedings of the American Philosophical Society. 8vo, 1880, pp. 511–598.

Notes on the Geology of the Iron and Copper Districts of Lake Superior. By M. E. Wadsworth. (Bull. Mus. Comp. Zoöl., Geol. Ser., Vol. I.) 8vo, pp. 157, pls. 6, 1880. From the author.

Descriptions of new species of North American Fishes. By David S. Jordan. (From Proc. U. S. Nat. Mus.) 8vo, pp. 9, 1880.

Description of a new species of Sebastichthys (*Sebastichthys miniatus*) from Monterey bay, California. By D. S. Jordan and C. H. Gilbert. 8vo, pp. 6, 1880.

On the Generic Relations of *Platyrhina exasperata*. By D. S. Jordan and C. H. Gilbert. 8vo, pp. 1, 1880.

Notes on a collection of Fishes from San Diego, Cal. By D. S. Jordan and C. H. Gilbert. 8vo, pp. 12.

Description of a new Flounder (*Xystreurys liolepis*) from Santa Catilina island, Cal. By D. S. Jordan and C. H. Gilbert. 8vo, pp. 16, 1880.

Notes on Sharks from the Coast of California. By D. S. Jordan and C. H. Gilbert. 8vo, pp. 1, 1880.

Description of a new species of Ray (*Raia stellulata*) from Monterey, Cal. By D. S. Jordan and C. H. Gilbert. 8vo, pp. 7, 1880.

Description of a new Agonoid Fish (*Brachyopsis xyosternus*) from Monterey bay, Cal. By D. S. Jordan and C. H. Gilbert. 8vo, pp. 6, 1880. From the authors.

Remarks on the species of the genus Chirus found in San Francisco market, including one hitherto undescribed. By W. N. Lockington. 8vo, pp. 5, 1880.

Description of a new Fish from Alaska (*Cranidea microstoma*). By W. N. Lockington. 8vo, pp. 2, 1880.

Description of a new species of Agonidæ (*Brachyopsis verrucosus*), from the coast of California. By W. N. Lockington. 8vo, pp. 9, 1880. From the author.

Observations on Mount Etna. By S. P. Langley. (From the Amer. Jour. Sci. and Arts, Vol. XIX, July 1880.) 8vo, pp. 12, 1880. From the author.

Introduction to the Study of Mortuary Customs among the North American Indians. By Dr. H. C. Yarrow. 4to, pp. 6, 114, 1880. From the author.

Contributions to the Archæology of Missouri. By the Archæological Section of the St. Louis Academy of Science. Pt. I.—Pottery. 4to, pp. 30, maps 5, pl. 24, 1880.

Memoirs of the Geological Survey of India. Series X. Indian Tertiary and Post-Tertiary Vertebrata. Vol. I, pt. IV.—Supplement to Crania of Ruminants, pp. 172–181, pl. 21–24. Pt. V.—Suvalik and Marbada Proboscidia, pp. 182–300, pls. 29–45. By R. Lydekker. From the author.

The Valley Naturalist. Vol. ii, No. 1, 8vo. St. Louis, 1880. From the editor.

The Student. Vol. I, No. 1, 8vo, 1880. From the editors.

Palæontographica. Breiträge zur Naturgeschichte der Vorzeit. 4to, pp. 88, pl. 11. Cassel, 1880. From the editors.

Beiträge zur Kenntniss der Flussfische Südamerika's. Von Dr. Franz Steindachner. 4to, pp, 23, pl. 4, 1880. From the author.

Ueber den geologischen Ban der libyschen Wüste. Von. Dr. Carl A. Zittel. 4to, pp. 47, map 1, 1880. From the author.

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GENERAL NOTES.

BOTANY.

THE FERTILIZATION OF AQUILEGIA VULGARIS.—A note by Mr. Thomas Meehan, in the "Bulletin of the Torrey Club" for June, 1880, recording the perforation of the curved spurs of certain species of columbine, induces the publication of the following article, based chiefly on the observations of Sprengel[1] and Dr. H. Müller.[2]

As the plant commonly grows, the flowers are pendant. The five sepals are petaloid, nearly flat, and aid in rendering the flowers conspicuous. Each petal is somewhat funnel-shaped at its base, but quickly narrows into a slender tube 15–22 mm. in length, which is bent inward and downward at about 5 mm. from its free end, nectar being stored in the portion beyond the bend, where it is secreted by a glandular thickening of the wall.

The pendant position of the flower renders it inconvenient for lepidoptera to obtain the nectar, for if they would do so they must hang from the lower part of the flower, since their proboscides flex readily only in a ventral direction; and this position is not always to their liking. The length of that portion of the spur lying below the bend is a sufficient protection against the removal of nectar by bees with short tongues, and the curvature seems to be a pretty good way of excluding birds, which, as Prof. Todd has shown,[3] and as I have observed during the past spring, visit the flowers of our native *Aquilegia canadensis*. Thus it

[1] Entdeckte Geheimniss, 1793. S. 279.
[2] Befruchtung der Blumen, 1873. S. 118.
[3] AM. NATURALIST, Sept., 1880, p. 668.

appears that the nectar of these flowers is perfectly accessible only to insects whose slender and flexible suctorial mouth-parts reach a length of not less than 10 mm.; and these insects must be habituated to hanging upon flowers while probing them for their sweets. These requirements are met with only in certain humble bees. Sprengel records the flowers as being visited for their nectar normally, and fertilized, by large humble bees. Dr. Müller, from observations extending over a number of years, finds two species of Bombus which act in this way; the first, *B. hortorum*, has a tongue reaching a length of from 19–21 mm.; the second, *B. agrorum*, has a tongue varying from 12–15 mm. in length. When collecting nectar, one of these bees hangs upon the flowers with its prothoracic legs on the base of a spur, the mesothoracic and metathoracic limbs clinging to the column formed of the stamens and pistils. Inserting its head as far as possible into the flaring mouth of the nectary, it passes its tongue into the spur, the curve of which is readily followed when the insect occupies this position, in which the ventral surface of its body is brought in contact with the essential organs. But the flowers are proterandrous, the anthers only being mature in young flowers, while they are replaced by the receptive stigmas in older ones; so the bees, going from plant to plant, constantly cross older flowers with pollen from those which are younger, and, from their habit of visiting the lower (and older) flowers of a plant first, they usually cross the flowers of distinct plants. Where the nectar has been removed from flowers, the bees soon learn to probe only a single spur, and finding this empty, seem to reason that it would be a useless waste of time to try the others, and hasten on to another flower. Many years ago Necker proved the value of these nectaries for the fruiting of the flower, for he found that no fruit was set after their removal; but he does not seem to have arrived at the correct explanation of the result of his experiment.[1]

Concerning the perforation of the spurs of the corolla, Sprengel tells us that he found hive bees (? Bienen) on the flowers, which first collected pollen, then betook themselves to the bend in the spurs, which they bit through, thus readily obtaining the nectar. Dr. Müller found two small wild bees—species of Halictus—collecting pollen from the open anthers, but they showed no tendency to obtain nectar, and hive bees trying, failed. He found, however, that an humble bee *(Bombus terrestris)*, having a tongue not exceeding 9 mm. in length, and therefore debarred from partaking of the sweets with its more fortunate relatives, seemed to learn by individual experience the futility of attempting to reach the nectar in the normal way, afterwards acquiring the habit of

[1] Acta Academiæ Theodoro Palatinæ, v (*fide* Senebier). Soyer-Willemet also observed the same fact, and advances it on p. 13 of his "Mémoire sur le Nectaire" in support of his theory that nectar played a direct rôle in the act of fecundation.

alighting on the hook of the nectaries and perforating them on the convex side, securing their prize through the opening thus formed.

It is well known that one or more of our sixty-two North American species of Bombus habitually perforate flowers whose nectar is inaccessible to them normally; and from the shortness of the spurs of certain flowers like *Dicentra canadensis* and *D. cucullaria*, which, as every lover of our spring flowers must have noticed repeatedly, are invariably disfigured in this manner in some localities, it is to be inferred that some of these bees have very short tongues, though I am not aware that the species have ever been carefully compared in this respect. The individuals that Mr. Meehan found perforating columbines, in all probability did not possess tongues sufficiently long to enable them to obtain the nectar in the regular way.

While, therefore, *Aquilegia vulgaris* is visited normally to a certain extent by hive bees, small wild bees and short-tongued humble bees, which either in gathering pollen or trying to obtain nectar must, necessarily, aid in the cross-fertilization of the flowers, it seems perfectly adapted to profit by the visits of the long-tongued species of Bombus, and I must therefore depart from the conclusions of Mr. Meehan, that "the humble bee and the honey bee are evidently not the insects for which the Aquilegia had this beautifully contrived nectar cup provided to induce cross-fertilization, and what particular insect was designed to be the favored one, so that it and no other could turn its tongue around these twisted spurs to get at the honey in the end, I think no student has discovered," so far as to believe that the evidence in the case warrants the conclusion that certain species of "the humble bee" *are* evidently the insects for which the Aquilegia had its beautifully contrived nectar cup provided to induce cross-fertilization.—*William Trelease.*

Plants of Nova Scotia, Cape Breton and New Foundland.—The following list of plants represent the results of herborizing in an interesting region:

Thalictrum cornuti L., Torbay, N. F.
Ranunculus hyperboreus Roth., Open Hall, N. F. In black mud.
" *repens* L., Guysborough, N. S.
" *acris* L., Guysborough, N. S.
Sarracenia purpurea L., Arichat, Cape Breton island.
Drosera rotundifolia L., at Arichat, with *S. purpurea* L., and *Calopogon pulchellus* R. Br., in moist moss, and at Open Hall, N. F.
Stellaria media Smith, Guysborough, N. S., Torbay, N. F.
" *longifolia* Muhl., Torbay, N. F.
" *uliginosa* Murr., Torbay, N. F.
Cerastium viscosum L., Torbay, N. F., Guysborough, N. S.
Malva moschata L., Guysborough, N. S. Both the white and the purple-flowered forms common on roadsides.
Oxalis acetosella L., Guysborough, N. S.
Spiræa salicifolia L., Open Hall, N. F.
Poterium canadense L., Cape Broyle, N. F.
Potentilla norvegica L., Carbonier, N. F.

Potentilla tridentata Ait., Arichat, Cape Breton island. Extremely numerous over the treeless barrens above the village.
Fragaria vesca L. ? Arichat, Cape Breton island.
Rubus triflorus Richards, Arichat, Cape Breton island.
" *villosus* Ait., Torbay, N. F.
Rosa lucida Ehr., Carbonier and Open Hall, N. F.
Cicæa alpina L., Guysborough, N. S. This and *Oxalis acetosella* L., occur in enormous numbers over the moist shady hillsides in the vicinity of Guysborough.
Epilobium angustifolium L., Guysborough, N. S., Cape Broyle, N. F.
" *coloratum* Muhl., Torbay, N. F.
Œnothera fruticosa L., Guysborough, N. S.
" *chrysantha* Mx.
Heracleum lanatum Mx., Torbay, N. F.
Carum carui L., Guysborough, N. S. Escaped and become a very troublesome weed in meadows.
Aralia nudicaulis, L., Cape Broyle, N. F.
Cornus canadensis L., Guysborough, N. S.; Arichat, Cape Breton island, and Cape Broyle, N. F. Very abundant.
" *stolonifera* Mx., Cape Broyle, N. F.
Linnæa borealis Gronov., Cape Broyle and Bay of Bulls, N. F. Forming very dense mats on the exposed rocky hillsides.
Viburnum nudum L., Cape Broyle, N. F.
Galium asprellum Mx., Guysborough, N. S.; Torbay, N. F.
" *trifidum* L., Arichat, Cape Breton island.
Aster æstivus Ait., Cape Broyle, N. F.
" *lævis* L., Cape Broyle, N. F.
" *nemoralis* Ait., Open Hall, Bay of Bulls, N. F.
" *purniceus* L., Cape Broyle, N. F.
Diplopappus umbellatus Torr. et Gr., Cape Broyle, N. F.
Solidago thyrsoidea E. Meyer, Cape Broyle, N. F.
" *altissima* L., Cape Broyle, N. F.
Achillæa millefolium L., Torbay, N. F.
Senecio vulgaris L., Torbay, Cape Broyle, N. F.
Centaurea nigra L., Torbay, N. F.
Leontodon autumnale L., Guysborough, N. S.
Nabalus nanus D. C., Torbay, N. F.
Campanula rotundifolium L. Torbay, N. F.
Vaccinium canadense Kalm., Cape Broyle, N. F.
" *macrocarpum* Ait., Arichat, Cape Breton island.
" *oxycoccus* L. Arichat, Cape Breton island.
" *pennsylvanicum* Lam., Cape Breton island.
" *vitis-idæa* L., Open Hall, N. F.
Chiogenes hispidula Torr. et Gray, Guysborough, N. S.
Kalmia angustifolia L., Arichat, Cape Breton island; Cape Broyle, N. F.
Ledum latifolium Ait., Cape Broyle, N. F.
Pyrola elliptica Nutt., Guysborough, N. S.
" *secunda*, Open Hall, N. F.
Plantago maritima L., Guysborough, N. S.
Trientalis americana Pursh., Cape Broyle, N. F.
Lysimachia stricta Ait., Guysborough, N. S.
Veronica chamædris L., Guysborough, N. S. Found quite abundant in a shady ravine.
" *serpyllifolia* L., Torbay, N. F.; Guysborough, N. S.
Euphrasia officinalis L., Guysborough, N. S.; Arichat, Cape Breton island.
Rhinanthus crista-galli L., Guysborough, N. S.; Cape Broyle, N. F.
Melampyrum americanum Mx., Arichat, Cape Breton island.
Lycopus virginicus L., Bay of Bulls, N. F.
Brunella vulgaris L., Arichat, Cape Breton island.
Scutellaria galericulata, Guysborough, N. S.
Galeopsis tetrahit L., Open Hall, N. F.
Myosotis verna Nutt., Torbay, N. F.
Ipomœa pandurata Meyer, Guysborough, N. S.

Urtica dioica L., Torbay, N. F.
Juniperus communis L., Bay of Bulls, N. F.
Larix americana Mx., Bay of Bulls, N. F.
Habenaria lacera R. Br., Guysborough, N. S.
Goodyera repens R. Br., Open Hall, N. F.
Spiranthes romanzoviana Cham., Carbonier, Cape Broyle, N. F.
Calopogon pulchellus R. Br., Arichat, Cape Breton island.
Juncus effusus, Arichat, Cape Breton island.
Carex rostrata Mx., Arichat, Cape Breton island.
" *vulgaris* Fries, Arichat, Cape Breton island.
Agrostis vulgaris With., Cape Broyle, N. F.
Festuca ovina L., Redcliffe island, N. F.
Poa annua L., Guysborough, N. S.
" *debilis* Torr., Cape Broyle, N. F.
Aspidium spinulosum Suz., Cape Broyle, N. F.
Lycopodium annotinum L., Bay of Bulls, N. F. —*Henry L. Osborn.*

BOTANICAL NOTES.—The new "students' garden" at Kew is an excellent design, well calculated, if properly cared for, to foster a knowledge of botany, and excellently adapted to impart an idea of what botany means to the many thousands of visitors who make excursions to the gardens. The *Gardeners' Chronicle* has recently advocated the establishment of "school gardens," where practicable, and we see no reason why they should not be established wherever there is a public park. In several continental countries they can be counted by hundreds, and in the country of Linnæus by thousands.——In a recent paper on the impurities of drinking water caused by vegetable growths, published by Prof. W. G. Farlow in the first annual report of the Massachusetts Board of Health, attention is especially called to the Nostoc group. These bluish-green algæ so long as they are living and not excessively abundant, produce no perceptibly bad effect on the water, but when they decay in large quantities they give rise to the pig-pen odor, as it is called, which has in recent years caused considerable trouble and still more alarm. The water thus affected becomes too offensive to drink, and cannot be entirely purified by filtering. No absolute remedy is suggested or probably can be, but ponds should be cleared of weeds and substances in which the nostocs may lodge and develop, and the water in the pond should not be allowed to fall rapidly. One of the two plates illustrates the harmless desmids, etc., and the second the injurious nostocs.——It appears that the Ningpo hats, of which 15,000,000 were exported in 1877, many being sold in the Southern United States, are made from a sedge, *Cyperus tegetiformis*. ——The development of the colors of flowers is discussed by Dr. Hermann Müller in *Kosmos*.

ZOÖLOGY.[1]

A RELATION BETWEEN METEOROLOGY AND THE GRASSHOPPER OR LOCUST PEST.[2]—In the winter of 1877–1878 I made a short

[1] The departments of Ornithology and Mammalogy are conducted by Dr. ELLIOTT COUES, U. S. A.

[2] Read before the National Academy of Sciences.

preliminary study of some of the relations of climate to the so-called "locust pest" of our Western States. An abstract of my results was published in chapters VII (pp. 203–211) and XV (pp. 424–432) of the "First Annual Report of the U. S. Entomological Commission for the year 1877 relating to the Rocky Mountain Locust, &c., &c."

Although the results then arrived at were crude because of the paucity of proper material, yet as nothing better has since then appeared and as the subject has not come to the notice of some who might aid in securing further precise data, I will take the liberty of bringing the matter to the attention of the naturalists of the Academy, to whom we must look for the accurate determination of the thermal constant that we need in order to attain to results that may be practically useful to the community—premising only that I have merely broken the ground for some one else to build.

My idea is that it would be an important advance toward protecting the agricultural districts if we were able at any day to say: "Up to this date the grasshopper eggs have been rapidly (or slowly) progressing towards hatching, and they are now within five (or other number) days of appearing."

But in order to accomplish this we must know the normal time of incubation, which probably must depend principally upon the temperature to which its egg is exposed, and upon the peculiarity of the locust egg as an organized body having the inherent vital power of development.

The meteorologist and the biologist must here work in union. I have, however, presumed for the first effort to undertake at least an approximate solution of both questions, and present here the conclusions that are given at greater length in the pages before referred to.

I. The Heat of Incubation.—It may be assumed that in these eggs, as in all similar animal and vegetable germs, a certain definite amount of heat represented by an exposure for a definite number of hours to a uniform, definite temperature will always effect the hatching of the young. From the study of the observations made by Dr. C. V. Riley, I concluded that at temperatures below 50° Fah., the development of the egg progresses very slowly if at all—although the vitality is not destroyed by temperatures of 15° F. I found that the few available observations led to the following approximations:

1. At a uniform temperature of 50° F. the eggs require 65 whole days or 1560 hours to hatch.
2. " " 60° " " 60 " " 1440 " "
3. " " 70° " " 55 " " 1320 " "
4. " " 80° " " 50 " " 1200 " "

It may be that at higher temperatures the development proceeds at a more rapidly increasing rate; indeed, one correspondent says that at a temperature of 100° F. the eggs hatched out in a few hours—but nothing is known as to whether the eggs were fresh or not, and the observer's name itself is also unknown, there-

fore I have restricted the above table to that range of temperature within which we have satisfactory observations, and which corresponds most nearly to what generally occurs in practice.

The above table may also be put in the general algebraic form:

$$\text{In hours } H = 1560 - 12\,(T - 50^\circ)$$
$$\text{In days } D = 65 - \tfrac{1}{2}\,(T - 50^\circ)$$

where T represents the average temperature to which the eggs are exposed. We see from this that the heat received by the eggs while resting for sixty-five days in a light, dry, sandy soil at a uniform temperature of 50° F. is the least that will hatch them, while the additional term ½ (T—50°) represents the acceleration of the process consequent upon maintaining a higher temperature.

II. The Temperature experienced by the Eggs in the Ground.—In order to apply the results of the preceding section we must know the temperature of the ground in which the eggs are deposited, that is to say especially the duration of such temperatures as are above 50° F.

Actual observations of the soil at depths of one-half, one, one and a-half, two inches, &c., are, so far as I know, sadly lacking in this country, and rarely to be found in Europe, although very much needed in special investigations. An exhaustive review of our knowledge on the subject of earth temperatures has been published, during the past year, by Wild, of St. Petersburg, but it is concerned mostly with temperatures at greater depths than six inches, and relates, therefore, to terrestrial physics rather than to agricultural interests.

In the absence of direct observations, I have therefore adopted as a working hypothesis some empirical approximate relations between the air temperatures (published in the annual report of the Chief Signal Officer, Gen. A. J. Myer) and soil temperatures at the depth of one-half inch, from which I have deduced the following table showing for each station the total number of hours in each month during which the eggs must have been exposed to temperatures of over 50° and reduced to an equivalent of 60°.

Month.	Fort Garry. Lat. 50°	Breckenridge. Lat. 46.5°	Yankton. Lat. 42.5°	North Platte. Lat. 41.5°	Dodge City. Lat. 37.5°	Corsicana. Lat. 32.0°
1875.						
July	558	434	496	558	620	744
August	372	310	372	496	558	744
September	324	406	480	540	600	720
October	48	180	273	348	540	600
November	0	36	60	72	264	464
December	0	0	28	60	144	372
1876.						
January	0	0	20	20	120	324
February	0	0	24	64	150	324
March	0	0	0	54	104	464
April	66	78	184	276	324	600
May	324	290	366	464	558	744
June	504	420	480	540	600	720

By adding up the number of hours in each vertical column of

this table, we obtain the total duration of exposure to a hatching temperature of 60° F., or the total progress that the egg has made toward the full complement of 1440 hours required for hatching according to the results of section 1.

For example, eggs laid so late as the 1st of September, 1875, at the respective stations, would have made progress and would hatch about as follows:

Station.	Latitude.	Eggs laid September 1, 1875						Average dates of hatching Riley Locust Plague.
		Will have experienced				Will hatch		
Fort Garry .	50°	1264 hours of temperat'e 60°			by June 30	Early in July, 1876		June
Breckenridge	46.5	1410	"	"	" June 30	"	"	3d week in May
Yankton .	42.5	1407	"	"	" May 31	"	June "	Middle May
North Platte	41.5	1434	"	"	" April 30	"	May "	First of May
Dodge City .	37.5	1404	"	"	" Nov. 30	During	Dec., 1875	April
Corsicana . .	32°	1320	"	"	" Oct. 31	"	Nov., "	March

This table agrees roughly with the dates published in Riley's Locust Plague, p. 97, but is here given only as a sample of what should be possible when we have a better determination of the heat of incubation and have actual observations of the temperature of the soil. In such case we should week by week, as the season advances, make up a statement of the actual progress of the eggs towards the completion of their period of incubation, thus giving the husbandman abundant warning of the birth of the young insect, and giving him more precise data by which to determine, in any case, the best date to plant or sow in order to avoid the ravages of the pests.—*Cleveland Abbe.*

Forster's Tern in Florida.—Forster's terns (*Sterna forsteri* Nutt.) were quite common here for two months, November and December, 1879. One specimen was secured. Mr. J. A. Allen (On Mammals and Birds of East Florida) says, "I have no evidence of its occurrence here at this season."—*Thomas W. Wilson, Seville, Volusia Co., Fla.*

An Early Season.—This year (1880) the Batrachians were stirring very early. I heard "peepers" (*Hyla pickeringii* Holb.) March 4, and was told that they had been heard twice before (February 29, and the other still earlier date not stated).

February 26 a full-grown *Amblystoma punctatum* was brought to me alive. It was found in the woods. March 30 I saw as many as thirty bunches of eggs of *A. punctatum* in the water. I think this salamander lays its eggs by the middle of March, regardless of cold. For a few days during the last of February and the first of March the weather was warm and spring-like, but after that it became so cold that the pools were coated with ice several times.

Another peculiarity of this season was the excessive drought in May, which dried up several of the pools. Since then the rains have filled them again, but the salamanders have disap-

peared. They were not developed enough at the time to leave the water, and so probably perished.

In one pool I found an abundance of the half-grown larvæ of *H. pickeringii* or *Hyla versicolor*, but they were the only Batrachians seen. Usually one can find as many as six varieties in this place. Either the tree toad larvæ were not hatched, or they have a way of caring for themselves when the water dries up, better than other species.—*S. P. Monks.*

A Fresh Water Jelly Fish.—An adult medusa belonging to the order Trachymedusæ, allied to Aglauropsis from the coast of Brazil, was observed by Mr. Sowerby in the tank in the water lily house in Regent's Park, London, June 10th. It occurred in great abundance in perfectly fresh water at a temperature of 90° Fahr. Mr. Sowerby observed the medusa feeding on water fleas (Daphnia). The specimens were adult males, and are described by Prof. Ray Lankester in *Nature* for June 17, under the name of *Craspedacusta sowerbii*. It was probably introduced from the West Indies. This is the first instance known of fresh water jelly fishes; Hydra and Cordylophora being, so far as we are aware, the only fresh water Hydroids. The succeeding number of the same journal contains additional valuable descriptions of the same medusæ by Prof. Allman and Mr. G. J. Romanes.

Zoological Notes.—It seems that kangaroos have increased in the Australian colonies so as to become a serious evil. On one run, in the Stanhope district, it was computed that there were at least 60,000 head of marsupial animals, every one of which will eat as much as a sheep. On a run in Queensland visited by Mr. Inglis, there were 40,000 head of sheep, and the owner had destroyed more than that number of kangaroos.——It is well known that snakes swallow their young in case of danger; Mr. E. G. Blackford now states that ten sharks, two feet in length and apparently about six months old, were taken from the stomach of a mackerel shark *(Lamna punctata)*, as if they had got there to avoid danger. Still it is probable that sharks may eat their young.——Mr. W. S. Ball, of Greensboro, N. C., complains that swarms of honey bees attacked his grapes, "destroying nearly half."——The first part of a new volume, the first, of Bronn's Thier-reichs, on the Protozoa, by Dr. O. Bütschli, has appeared. This will undoubtedly prove to be the best general work on these organisms, and will be of much interest to microscopists. An English work on the Infusoria, by W. Saville Kent, is announced to begin to appear in the autumn in monthly parts. ——In Prof. Newton's article on the goose, in the *Encyclopædia Britanica*, he remarks that the predominance of the white variety in domestication may be due in part to the practice of plucking the birds alive, "for it is well known to bird-keepers that a white feather is often produced in place of one of the natural color that

has been plucked out." The reviewer adds that saddle-galls on horses become covered with white hairs; and that he possesses a black cat which has a white star on its head where it was picked by a fowl in kittenhood.——The stridulating organs of spiders have been described by Westring and Mason Wood; those of still other spiders (*Steatoda guttata* and *Linyphia tenebricola*), of both sexes, have recently been described by Mr. F. M. Campbell.—— It is claimed by M. Pasteur that earth-worms carry about the bacteridium germs of the disease called anthrax in their alimentary canal; that the dust of the earth mixed with the infected blood gets blown about the herbage with the worms' excrement, and the cattle devouring the grass become infected.——Soon to be published is Mr. St. George Mivart's "The Cat; an introduction to the study of back-boned animals, especially Mammals."——A number of new species of spiders from the Western and Southern States, though mostly from the Pacific coast of South America, are described by Count Keyserling in the Transactions of the Imperial Zoölogical and Botanical Society in Vienna for 1880.—— In an essay in the *Morphologischer Jahrbuch* on the anatomy of dibranchiate Cephalopoda or cuttles, Dr. Brock discusses the phylogeny of these animals. He thinks that the Octopods, or poulps, have been derived from shell-bearing forms, Argonauta having, in the young, the rudiment of a shell capsule, while Cirroteuthis, which is not a true Decapod, has an internal shell; while the ink-bag is originally a part of the hind gut, in Sepia only is it connected by a long efferent duct with the anus. He then asks how Sepia came to retain its shell, when in other cuttles it is simply horny. He thinks that Sepia may be a direct descendant of the belemnites.

ANTHROPOLOGY.[1]

ANTHROPOLOGY AT THE AMERICAN ASSOCIATION.—Of the hospitality and general enthusiasm which characterized the Boston meeting, accounts will be found elsewhere and especially in the *Daily Boston Advertiser* from Aug. 26th to Sept. 2. Our purpose is to give a list of the anthropic papers and a brief sketch of their contents.

1. Ethnology of Africa. A. S. Bickmore.
2. Myths and folklore of the Iroquois. Erminnie A. Smith.
3. Prehistoric altars of Whiteside county, Ill. W. C. Holbrook.
4. Theory of primitive democracy in the Alps. D. W. Ross.
5. Ancient mounds near Naples, Ill. J. G. Henderson.
6. The mounds of Illinois. Wm. McAdams.
7. Prehistoric and early types of Japanese pottery. E. S. Morse.
8. Scheme of the tenth census for obtaining statistics of untaxed Indians. Garrick Mallery.
9. Stone implements from the river drift of New Jersey. C. C. Abbott.
10. Indications of Pre-Indian occupancy of the Atlantic coast of North America subsequent to that of palæolithic man. C. C. Abbott.
11. The probable existence in America of the prehistoric practice of trepanning in the cutting of rondelles or amulets from the skull. R. J. Farquharson.

[1] Edited by Prof. OTIS T. MASON, Columbian College, Washington, D. C.

12. The Dacotah tribes. Gen. H. B. Carrington.
13. Textile fabrics of the ancient inhabitants of the Mississippi valley. J. G. Henderson.
14. Engraved tablet from a mound in Ohio. W. J. Knowlton.
15. Japanese caves. E. S. Morse.
16. Ancient agricultural implements of stone. Wm. McAdams.
17. Alabaster quarries, flint mines and other antiquities of Mammoth, Wyandot and Luray caverns. H. C. Hovey.
18. The classification of kindred by the N. A. Indians. J. W. Powell.
19. On the Iro-quois languages. Erminnie A. Smith.
20. On the rank of the Indian languages. J. W. Powell.
21. Remarks on the mound-builders. J. F. Everhart.
22. Contemporaneous existence of mastodon and man in America. R. J. Farquharson.
23. Conventionalism in ornamentation of ancient American pottery. F. W. Putnam.
24. On the occurrence in New England of carvings by the Indians of the N. W. coast of America. F. W. Putnam.
25. Sign-language and pantomimic dances among North American Indians. J. G. Henderson.
26. The topographical survey of the works at Aztalan, Wis. S. D. Peet.
27. The military system of the emblematic mound builders. S. D. Peet.
28. Improved stereograph for delineating the outlines of crania. A. S. Bickmore.
29. Feeling and function as factors in human development. Lester F. Ward.
30. The uses of the "chungkee-stone." Alfred M. Mayer.
31. Relation of the archæology of Vermont to that of the adjacent States. Geo. H. Perkins.
32. Exhibition of some gambling games of the Iroquois. Erminnie A. Smith.
33. Parturition in a kneeling posture as practiced by the women of the mound-building and stone-grave peoples. C. Foster Williams.
34. The antiquity of man in Eastern America geologically considered. Henry C. Lewis.
35. A comparison between the shells of Kjökkenmöddings and present forms of the same species. E. S. Morse.
36. Antiquities of Onondaga county, N. Y. W. W. M. Beauchamp.

The address at the opening of the subsection of anthropology, by Major J. W. Powell, the chairman, was upon the social organization of the Wyandotte Indians. This was an original investigation covering the entire sociological system of that tribe. The material was gathered from Gray Eyes, a Wyandotte chief, during a six months' residence in Washington the past year. Below will be found abstracts of the papers in the order of the titles above.

1. Prof. Bickmore exhibited a large map of Africa colored to indicate the distribution of the various races of men over the African continent. The map will be on permanent exhibition at the Museum of Natural History, New York city.

2. Mrs. Smith, having spent a season among the Onondagas with superior facilities for studying their habits, gave a series of myths collected by the people themselves.

3. The prehistoric altars of Illinois are structures made of slabs of undressed stones in two or three layers, about ten inches high, and containing charred remains.

4. Mr. Ross took issue with Mr. Freeman in his theory of the origin of democratic institutions as found at the present time in Alpine communities.

5. The author of this paper is himself an enthusiastic explorer, and exhibited a collection of crania and mound relics which he had exhumed with his own hands. The theory of a homogeneous race of mound-builders appears to be confuted by these investigations. Indeed the author seems to think that there were as many races of mound-builders as there are of modern Indians.

6. Mr. McAdams, an intelligent farmer from that portion of Illinois lying near to the Mississippi bottoms and the mouth of the Illinois river, has spent twenty-five years in the explorations which he described in a straightforward, modest communication which held the attention of the subsection undiminished to its close.

7. Prof. Morse began by saying that the Japanese, as a race, are exceedingly fond of the past, and that in almost every well-to-do tradesman's house could be found a fine collection of ancient objects of interest. The author of the paper is of the opinion that the shell-heap pottery is very ancient, and that the indications of Aino origin are fallacious.

8. Col. Mallery has been employed for the past few months, under the patronage of Gen. Walker and of the Bureau of Ethnology in Washington, in devising a scheme for securing a census of the untaxed Indians of the United States, that will include answers to all questions bearing upon their sociology. This was one of the most carefully prepared and valuable papers read before the subsection.

9, 10. Dr. Abbott is well known as the discoverer of palæolithic implements in the drift gravels of New Jersey. His latest investigations lead him to conclude that there were two areas of population in New Jersey anterior to the modern Indians; the palæolithic people of the drift and a later argillite chipping people, whose implements are found in the marsh deposits overlying the drifts.

11. Dr. Farquharson exhibited a series of crania upon which trepanning had been practiced after death, and among them one or two which gave indications of operation during life.

12. The paper of Gen. Carrington was rather a noble plea for the Indians, founded upon long acquaintance, than a scientific dissertation.

13. Mr. Henderson exhibited before the subsection, specimens of the raw material of every substance known to have been used by the Pre-Columbian Indians in spinning and weaving, models of all the spinning and weaving apparatus of which we have any knowledge, and specimens of all kinds of manufactured articles. The paper was an exhaustive résumé of what has been written on the subject, together with the author's own observations.

14. The tablet was exhibited and resembles very closely the celebrated Cincinnati tablet.

15. Prof. Morse gave an account of personal investigation of

Japanese caves under great difficulties, and the finding of ancient pottery and remains.

16. The agricultural implements described were a set of thin flaked hoes collected on the ground by the author.

17. Mr. Hovey having examined and surveyed the caves mentioned in his paper, described the remains of man and of his industry to be met with therein.

18. Major Powell, with the aid of the entire corps of the Bureau of Ethnology under his charge, has constructed a series of charts to accompany a new edition to his Introduction to the Study of the North American Indians. These charts, by means of simple and graphic symbols, indicate at a glance nine generations, including that of *ego*, four above and four below, also sex, consanguinity, affinity and the effect of marriage upon the gens of the offspring. The paper of Major Powell was an accurate account of the purport of these charts, which are to be lithographed and distributed to all anthropological observers.

19. Mrs. Smith gave a sketch of the grammar and vocabulary of two Iroquois dialects, at the same time presenting a manuscript collection of words and phrases.

20. Major Powell read a very carefully prepared paper, giving the results of a long study upon the structure of our North American Indian languages. As the paper will be published in full an abstract will not be attempted.

21. Mr. Everhart's paper was a recital of his own experiences in mound exploration. A very puzzling slab or tablet was exhibited bearing graphic signs similar to some on the Davenport tablets.

22. The text of Dr. Farquharson's paper was the elephant pipes found near Davenport, and described in the Proceedings of the academy of that place, Vol. 11, p. 348.

23, 24. Mr. Putnam's papers will appear in detail in the Annual Report of the Peabody Museum, Cambridge.

25–27. We have received no abstracts of these papers.

28. The stereograph of Mr. Bickmore differs from that of Dr. Broca, 1. In the method of fastening the skull to the upright column; 2. In the precision with which the whole may be turned at any angle with the vertical copying surface; 3. In the device for carrying the pen in order to secure a smooth and exact line; 4. In the facility with which the pencil may be reversed. The apparatus is far more expensive than Broca's, but a large number could be made very much cheaper.

29. Mr. Ward's paper was a contribution to the metaphysics of anthropology upon a side which has always interested us, but which has received comparatively little treatment. Man is here regarded as endowed with feelings or desires, involving the effort and activity to gratify them. The gustatory and sexual appetites (and, we would add, desire to be at peace with climatic environ-

ment) are the primary and essential factors. Mr. Ward presented an elaborate schedule of human wants.

30. Mr. Mayer presented to the association a beautiful specimen of a polished "chungkee stone," and from indications upon it argued that the common interpretation of their function is correct.

31–34. No abstracts have been furnished.

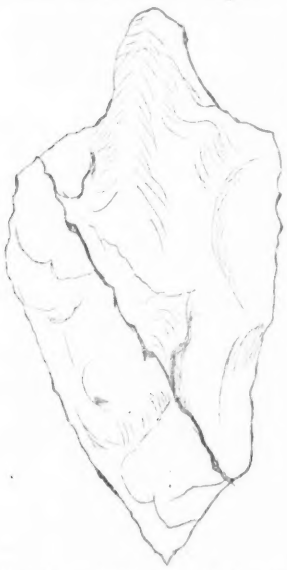
35. The purport of this paper may be learned from Mr. Morse's letter in the NATURALIST for September, pp. 656–662.

The next meeting will be held in Cincinnati, with Col. Garrick Mallery as chairman, and Judge J. G. Henderson as secretary. A section of anthropology will then be formed.

The Saratoga volume of the association, just issued, contains the following papers in full:

The Sign Language of the North American Indians, by Garrick Mallery, U.S.A.
On the Explanation of Hereditary Transmission, by Louis Elsberg.
Notes on the Archæology of the Champlain valley, by George H. Perkins.
Mythologic Philosophy. Address of Major John W. Powell, vice-president section B.

UNSYMMETRIC LANCE-POINTS.—While examing the archæological collections of Peter Neff, Esq., at Gambier, Ohio, I discovered a flint lance or arrow-point of such peculiar shape and workmanship as to merit a figure and full description. The piece of flint, 3.25 inches in length by 1.70 inches in greatest width, has been rudely shaped. Across the face of the stone there extends a natural vein having the appearance of a flaw. It is evident that after undertaking to form a lance-point from the whole chipping, the maker changed his mind and concluded to make a smaller and more perfect specimen by ingeniously using this vein for one of the sides. The accompanying figure brings out this fact clearly. The specimen is symmetrical and beautifully formed. Marks from an attempt to break the specimen along the vein, are seen near both extremities. On page 292, Vol. XIII, of the NATURALIST, Prof. Haldeman figured a number of unsymmetrical arrow-heads and allied forms, one of which (Fig. 8) bears so close a resemblance to our specimen as to lead to the inquiry whether the same explanation may not be given in both cases.—*E. T. Nelson, Ohio Wesleyan University.*



Found near Walhonding, Coshocton county, Ohio, in 1879.

GEOLOGY AND PALÆONTOLOGY.

THE BAD LANDS OF THE WIND RIVER AND THEIR FAUNA.—These bad lands are situated in the upper drainage basin of the Big Horn river in Western-central Wyoming. Dr. Hayden, who first reported their existence, has referred them to the Wasatch Eocene (see AMERICAN NATURALIST 1878, p. 831). Explorations which I have recently set on foot and placed in charge of Mr. J. L. Wortman, have resulted in the discovery of an interesting fauna, which quite confirms Dr. Hayden's determination of the age of the formation. Mr. Wortman has obtained nineteen species of *Mammalia*, of which nine are new to science, and five have been already found in the Wasatch beds of New Mexico. The following list is given preliminary to further remarks. Rodentia (1–2); *Plesiarctomys*, two species. Mesodonta; *Hyopsodus*, *Pantolestes*, and *Tomitherium*, one species each (5). Chiroptera.

(6) *Vesperugo anemophilus* sp. nov. Represented by the anterior part of a skull without lower jaw. Dentition, I. ?C. 1; P-m. 2; M. 3. Posterior molar narrow, its posterior external V. rudimental; first and second molars subequal. Fourth premolar elevated and acute, with an external basal cingulum; second premolar simple, acute. Profile steeply elevated behind orbital region, less steep in front of it; zygomas wide. Length from interorbital region to above canine alveolus in front .010; interorbital width .005; width of zygomas .012; do. between outsides of last molar teeth .010; length of molar series .008; do. of true molars .004.

Creodonta. (7) *Protopsalis tigrinus* gen. et spec. nov. *Char. gen.* Probably *Oxyænidæ*,[1] but as the type species is only known from two true molars and a canine of the inferior series with bones of the skeleton, this point remains to be ascertained. Femur with a weak third trochanter. Inferior molars, one like those of *Oxyæna*, *i. e.*, with large heel and internal cusp; another, probably the last, larger, without internal tubercle, and with rudimental heel, thus resembling the inferior sectorial of various existing *Carnivora*. *Char. specif.* Size about that of the tiger or jaguar, exceeding that of any other flesh-eater of the Wasatch epoch. The heel of the smaller tubercular-sectorial is not large, and has a plano-concave superior surface. The principal cusp is much elevated, while the internal cusp is small. The sectorial differs from that of a *Hyæna* in having the posterior cusp more and the anterior cusp less elevated; the heel is only a strong posterior cingulum, which is continued as a narrow line along the inner base of the tooth. A rough cutting ridge forms the posterior inner angle of the principal cusp. There is a wide longitudinal groove of the inner face of the inferior canine whose enamel surface is impressed punctate. The shaft of the femur is nearly straight. Diameters of crown of sectorial: anteroposterior

[1] See Proceed. Amer. Philos. Soc., 1880, July.

.025 m.; transverse .014; vertical .022. Length of heel of tubercular sectorial .006; width of same .006. Vertical diameter of base of crown of canine .022. Depth of mandible at last molar .042. Length of femur (condyles inferential) .300; diameter of shaft at middle .034.

(8) *Stypolophus strenuus* Cope. (9) *Stypolophus bicuspis* sp. nov. Smaller than the *S. minor* Filh., hence the least species of the genus. It is represented by a nearly complete skull with entire dentition of both jaws. Premaxillary bones rather elongate; general form of skull that of a civet. Crowns of second and third superior premolars compressed, with a prominent cusp behind the principal one. First and second true molars with two distinct external cusps and a strong external basal cingulum. Inferior first premolar one-rooted; third with a posterior heel, and fourth with strong anterior and especially posterior heels. Heels of true molars well developed (last broken). Length of superior dental series to I. 1, .031; do. of molar series .020; do. of true molars .006. Depth of mandible at second true molar .007; do. at canine .0035. The double lobed third premolar and the smaller size distinguish this species from the *S. viverrinus*.

(20) *Didymictis altidens* sp. nov. Represented by several specimens. The species is larger than the *D. protenus*, but the tubercular molar is relatively smaller, and has the three anterior cusps better developed. The heel of the tubercular sectorial is longer, and the three cusps more elevated than in *D. protenus*. Diameters of latter tooth: length anteroposteriorly .015; do of heel .006; elevation of external side of crown anteriorly .015; width at same point .009. Length of crown of tubercular .009; width of do .006; elevation anteriorly .005.

Amblypoda. (11) *Coryphodon* sp. indet. Perissodactyla. (12) *Palæosyops borealis* sp. nov. Founded on a portion of the right maxillary bone, which supports the three true molars and one premolar. Size of *Limnolyus fontinalis*, or much smaller than *P. lævidens*. Anterior median tubercle well developed; anterior and posterior cingula strong, not rising to inner cones. A low ridge extending outwards and forwards from posterior cone. Enamel smooth. Differs from *P. junior* Leidy in the presence of the intermediate tubercle and crest, and in the weak external cingulum. Length of true molar series .063; diameters of first true molar, anteroposterior, .019; transverse, .020.

(13) *Lambdotherium popoagicum* gen. et. sp. nov. *Char. gen.* Dentition much as in *Limnohyus*, excepting that there is a diastema in front of the second inferior premolar. Presence of first inferior premolar not ascertained. Fourth inferior premolar without posterior cusps. Superior molars with an angular ridge extending inwards from each inner cusp. Last inferior molar with heel. This genus differs from *Oligotomus* in the simplicity of the fourth premolar, which has, in the latter, two posterior

cusps. The V-shaped crests of the inferior molars separate it from *Hyracotherium*. *Char. specif.* The heels of the second and third premolars have a median keel; the third only has an anterior tubercle. The crest of the heel of the fourth forms an imperfect V. Heel of the last true molar small. No cingula; enamel smooth. Length of molar series .080; of true molars .044; of last molar .019; depth of ramus at first premolar .021; at last molar .031. Second specimen. Diameters of crown of last superior molar: anteroposterior .014; transverse .016. About the size of the *Hyrachyus agrestis*. Three individuals.

(14) *Hyracotherium angustidens* Cope, jaws of three specimens. (13) *Hyracotherium vasaccicnse* Cope, one jaw. (16) *Hyracotherium vortmani* sp. nov. About the size of the *H. tapirinum* Cope, but with the opposite cones of the inferior molars not united by cross-crests. There is a tubercle between the posterior pair of the first inferior true molar. The anterior tubercles of the fourth premolar are close together, and there is a strong cusp anterior to these. No basal cingulum on this tooth. Length of molars 3 + 4 + 5, .025; depth of ramus at p. m. IV .018.

(17) *Hyracotherium craspedotum* sp. nov. Size of *H. tapirinum*, but the tubercles of the inferior molars are not connected by cross crests, and they all possess a strong external basal cingulum, which also extends round on the posterior base of the I and II true molars. Heel of fourth premolar with a diagonal ridge; two anterior cusps well separated, and no tubercle in front of them. Second premolar with narrow heel; last true premolar with wide heel. Length of molar series .056; of true molars .033; of last molar .014; depth of ramus at second premolar; .018 at last true molar .023.

(18) *Lophiodon calciculus* sp. nov. Represented by lower jaws of three specimens, one with superior molars. Transverse crests of inferior molars not connected by oblique ridges. Last true molar with a very small tubercle-like heel. A weak external basal cingulum; enamel smooth. Third and fourth premolars with wide heels, each with a single low ridge. Length of molar series .053; of true molars .033; of last true molar .014; depth of ramus at penultimate molar .025. Diameters of penultimate superior molar at No. 2: anteroposterior .012, transverse .014.

(19) *Lophiodon ventorum* sp. nov. Larger than the last, and differing in having a large heel of the last true molar, and an elevated external tubercle on the heel of the fourth premolar. Enamel wrinkled, no external cingulum. Second premolar with a very short heel with an acute tubercle. Length of molar series .064; of true molars .040; of last true molar .016; depth of ramus at second premolar .020; at third true molar .030. Two individuals in the collection.

From the preceding it appears that this fauna, though in general that of the Wasatch Eocene, present certain peculiarities.

Passing by the absence of fishes and crocodiles, which may yet be found, we have, for the first time, the association of *Palæosyops* with *Coryphodon*, genera hitherto characteristic of the Bridger and Wasatch beds respectively. The occurrence of true *Lophiodons*, for the first time exactly determined in America, is an interesting circumstance. Bats have not been recognized hitherto in the Wasatch formation.—*E. D. Cope.*

GEOGRAPHY AND TRAVELS.[1]

THE ROYAL GEOGRAPHICAL SOCIETY'S EXPEDITION TO LAKES NYASSA AND TANGANYIKA.—The serious misfortune which befell this exploring party in the loss of their leader, Mr. Keith Johnston, soon after their departure from the coast,[2] has not prevented the successful execution of the work assigned them. Mr. Thomson, who succeeded to the command, has completed his explorations, arrived back at Zanzibar and sailed for England about the middle of last July. His journey is the most important made in Africa during the past year. It is to be regretted that no observations could be taken, and that therefore Mr. Thompson's maps are not strictly accurate, but his descriptions, in his reports to the Society, of the countries and peoples visited, are clear and full, and contain much of great interest.

After the death of Mr. Johnston on the 28th of June, 1879, the expedition renewed its march over a country "half jungle, half forest," succeeded in a few days by a more varied tract broken by sharp ridges and narrow glens. Basalt appeared at the surface in a very discomposed form. In the glens there was an abundant flora, while on the tops of the ridges, owing to the too porous soil, everything green was shriveled up, even to the trees, under the fierce sun. "A porous surface stratum in Africa has always this result; if the surface is not damp and marshy it becomes a desert." Crossing the River Ruaha, one of the chief branches of the Lufigi, at about long. 37° E., lat. 8° S., it was found quite unnavigable even for canoes, owing to the rapids and rocks. The Uranga, the other branch of the Lufigi, is, however thought to be navigable for the largest river boats as far as the point visited at Mkomokero, in the M'henge country, and probably further.

The M'henge country is a plain kept constantly damp throughout the year at the base of the M'henge mountains, and is necessarily very fertile. It is about forty miles in length by twenty broad, and occupies the angle formed by the junction of the Ruaha and Uranga. The people are a superior race to the neighboring tribes. Their houses are generally built on poles, and are of the most peculiar character, in some cases being built on a platform with a huge roof (the house being circular) projecting

[1] Edited by ELLIS H. YARNALL, Philadelphia.

[2] See NATURALIST for October, 1879, p. 660.

all around and reaching a much lower level than the platform, so that nothing is seen but a large cone elevated on poles. The Uchungwe mountains were next crossed. They are a large number of mountains separated from each other and trending generally north and south along the edge of the great plateau reaching to the west, rounded in appearance and covered with vegetation. From east to west there is a general rise in altitude up to 7000 feet, and further south to 8000 and 9000. The plateau is about 6700 feet above the sea; its structure is of soft clay-slate till near Nyassa, where the rocks become volcanic.

Across this table land of Eastern and Central Africa, they pursued their way through a bleak, monotonous moorland-like country, very scantily inhabited and called Uhehe. The inhabitants (Wahehe) depend to a great extent upon their cattle. The climate is very trying. The temperature varies throughout the twenty-four hours from above 80° to below 50° with exceedingly cold north-west winds.[1]

On approaching the northern end of Lake Nyassa, Thomson crossed the lofty flat-topped ridge whose western escarpment descends abruptly to its shores, and was named by travelers on the lake, the Konde mountains, but appears now to be only the western edge of the great plateau. He reached Mbungo, near the head of the lake on September 22, 1879.

Starting again from Mbungo on the 28th, the expedition reached Pambete, on the southern shores of Lake Tanganyika, on the 4th of November. The width of the belt of land which separates these two great navigable lakes was found to be two hundred and fifty miles.

The Konde country which they first traversed lies at the northwest corner of Nyassa, and occupies a deep triangular indentation in the central plateau which bounds it on all sides except on the east. "Near the lake extends a broad plain of wonderful fertility, with a large population." At a height of 3000 feet they found a very broken, ridgy country. From the western limit of

[1] At a meeting of the Royal Geographical Society, Mr. Francis Galton, in speaking of the physical geography of this plateau region, alluded to the strong warm water current which sweeps down the south-east coast of Africa, producing extraordinary variations of temperature, marked atmospheric disturbances and peculiarities in the direction of the winds south of the Cape of Good Hope. "The southern part of Africa was a great plateau, across which the easterly winds that swept over the surface of the Indian ocean could not blow, but by which they were deflected. The mountainous plateau which south of Natal rose to an average height of 4000 feet, increased in height at the latitudes of Natal and Zululand, and now it had been ascertained by Mr. Thomson that at the side of Lake Nyassa it attained a height of 7000 or 8000 feet. There could, therefore, be little doubt that the deflection of the wind began north of the channel between Mozambique and Madagascar, and that the current was produced by the deflected portion of the winds of the Indian ocean that urged the sea before it, so that the peculiarities of the weather experienced far to the south of the cape, and the different courses that had to be followed by outward and homeward bound vessels, were primarily due to the physical conformation of the south-eastern corner of Africa, beginning with that part described by Mr. Thomson."

Konde, long. 33° 45′ E. and lat. 9° 22′ S., the extremely steep face of the plateau commences, and the ascent from 3300 to 6500 feet above sea level in the country of Nyika was made. The highest point reached was on the Munboya mountains at the elevation of 8180 feet. From these mountains the ground descends through barren woodland till long. 32° 45′ is reached, where the altitude is only 3300 feet. To the west Nyika is bounded by the Chingambo mountains, running north and south and rising to 5000 feet. These mountains are in long. 32° 45′ E. and lat. 90° 5′ S. On crossing them they were found to slope away gradually to the west. They then passed through Mambwe and Ulungu where the wooded ridges rise to 5000 feet to Tanganyika. Mr. Thomson believes the rise in the waters of Tanganyika to be periodical and according to the amount of rainfall.

Leaving Pambete on November 10th, Thomson established a permanent camp for his expedition at Liendwé, on the Lofu river, and then taking a few of his followers advanced into the country of Itawa, occupying a very hilly plateau and exceedingly difficult to march through. "There was not a mile of level ground, but hills followed hills, all of the most precipitous nature, varied only here and there by some lower ridge." The adjoining country of Marungu was also traversed, and presented even more difficulties. "The mountains rise to a height of 7000 feet with smooth rounded outlines, except where they face the lake. Large streams are numerous and must make the country almost impassable during the rains." The people also were most excitable and suspicious, and great difficulty was experienced in overcoming their hostility. As they approached the Lukuga both the country and the people improved; the mountains decreasing in altitude, and along the streams the fertile soil supports a large population who were friendly and hospitable. "Early on the morning of Christmas day," Mr. Thomson writes, "from the top of a high ridge I had the pleasure of seeing the Lukuga, as a noble river flowing with rapid movement and whirling eddy away to the far west, unchecked by sand bars or papyrus, and requiring no experiments with straws or other objects to ascertain the existence of a current." The barrier seen by Stanley was found swept away; the river, narrowed at this point, rushing through with great force so as to be utterly impassable for canoe or boat. "The barrier of mud and papyrus was swept away either two or three years ago, the waters of the lake having been rising till that time; since then there has been a fall of seven feet, according to the observations of Mr. Hore at Ujiji, who was also the first to see the Lukuga as an indisputable river."[1] From here he continued on to

[1] Mr. E. C. Hore, of the London Missionary Society, visited the Lukuga in April, 1879, and found it a large river flowing out of the lake. From the high ridge above the stream he saw it flowing outward as far as the eye could reach towards the Lualaba. Cameron and Stanley both visited the Lukuga in the dry season.—*Editor.*

Kasenge and Ujiji. No details of his return journey have been received as yet. He is known, however, to have followed the Lukuga for many days on its course to the Lualaba or Congo. He then returned by the lake to his camp, and finally reached the coast by a new route past the unvisited Lake Hikwa.

At the same time that Mr. Thomson was crossing from Nyassa to Tanganyika, the journey was being made by Mr. James Stewart, of the Mission station at Livingstonia. He left the former lake at Kambwe lagoon about twenty-five miles south-west from Mbungo, on October 14, 1879.

The ascent to the plateau was not so steep here as the R. G. S. expedition found it to be, and was accomplished in two days, when the elevation of 3900 feet was attained. Continuing to keep to the south-west of the route of Thomson, he found the average elevation of the plateau 4700 feet. The rain fall of the country is large, and its climate cool and bracing. The route over this plateau was a remarkably easy one, gradually rising from 3900 feet to 5400 at the ridge overlooking Tanganyika, and there is not one difficult ascent. The descent to the lake is gradual, and took two days. The distance from Kambwe lagoon to Pambete was found to be 254 miles. Here he met Mr. Thomson and remained with him until his departure, when Mr. Stewart returned to Nyassa, reaching it again on December 3d. The homeward march was only 232 miles in length, and could be shortened probably to 210.

In Chungu he found the trees thickly covered with large caterpillars three or four inches long and as thick as the fore finger. The natives were gathering them in great numbers, to preserve them for food. One kind was a light pea-green color, the other dark with white spots and sharp spines on the back.

MICROSCOPY.[1]

Permanent Microscopic Preparations of Plasmodium.—Mr. S. H. Gage advises picric acid as a means of hardening this interesting motile form of the Myxomycetes, without change of color as by osmic acid, or shrinkage and change of color by drying. Pieces of rotten wood containing plasmodium are placed on moistened microscopic slides, taking care that some of the protoplasm touches the slide, and the whole placed under cover to prevent drying. In an hour or so any plasmodium that may have crawled out upon the slide, may be fixed by placing the slide a few minutes in a mixture of equal parts of ninety-five per cent. alcohol and a saturated aqueous solution of picric acid. Yellow plasmodium may then be at once mounted, through absolute alcohol in balsam; but white forms should be first bleached in twenty-five per cent. alcohol.

[1] This department is edited by Dr. R. H. Ward, Troy, N. Y.

PERMANENT MICROSCOPIC PREPARATIONS OF AMPHIBIAN BLOOD.—The very excellent method of drying the corpuscles of mammalian blood on the microscopic slide, is not applicable to the much more bulky corpuscles of Amphibia. The corpuscles of the latter are sure to be distorted and seamed in drying; hence various methods of preserving the corpuscles moist have been tried with varying success.

The following very great modification of the method proposed by Ranvier in his treatise on histology,[1] has been in use for some time in the Anatomical Laboratory of Cornell University, and has given uniformly excellent results. Preparations made three years ago are quite as good as at first.

Three or four drops of fresh blood are allowed to fall into 10 cc. of normal salt solution (common salt 750 milligrams, water 100 cc.) preferably contained in a high narrow vessel like a graduate glass or beaker. The mixture of blood and salt solution should be well agitated and then 100 cc. of a saturated aqueous solution of picric acid added with constant stirring. After the corpuscles have settled, as much of the supernatant liquid as possible is poured off, and in its place is put about an equal volume of normal salt solution. The corpuscles are allowed to settle, the liquid poured off and another volume of salt solution added. This is continued until the salt solution acquires only a faint yellow tinge.

The use of the salt solution is, first, to dilute the blood in order to avoid distortion of the corpuscles, and second, to wash away the picric acid so that the subsequent staining will be more satisfactory.

After pouring off the last salt solution, there is put in its place 10 cc. of a mixture of five parts of Frey's carmine and ninety-five parts of picrocarmine. The corpuscles will stain in from one to fifteen hours. A drop of the agitated mixture should be examined occasionally to ascertain when the staining is sufficient. The nucleus should be deep red, and the body of the corpuscle yellow or pinkish.

When the staining is completed, as much stainer as possible should be poured off, and in its place 10 or 15 cc. of acid glycerine (glycerine 100 cc., acetic or formic acid 1 cc.). This mixture of corpuscles and glycerine may be placed in a bottle and used at any time, it being simply necessary to agitate the mixture slightly or to take up some of the sediment with a pipette and mount it precisely as any other glycerine preparation.

Summary.—1. The fresh blood is first diluted with about fifty times its volume of normal salt solution.

2. To this diluted blood is added ten times as great a volume of a saturated aqueous solution of picric acid.

3. The picric acid is washed away with normal salt solution.

[1] Traité technique de Histologie, p. 195.

4. The corpuscles are stained with picrocarmine, or a mixture of this and Frey's carmine.

5. They are preserved in acid glycerine, and may be mounted for the microscope at any time.—*Read at the sub-section of Microscopy of the A. A. A. S., by Simon H. Gage, Ithaca, N. Y.*

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SCIENTIFIC NEWS.

— The U. S. Entomological Commission had a prolonged session in June, immediately after the adjournment of Congress, and since then the members and their assistants have been in the field. As during the previous year the labor was divided, so that Prof. Riley took charge of the cotton worm investigation, while Profs. Packard and Thomas prosecuted the study of the Rocky Mountain locust in the Western Territories.

The organization of Prof. Riley's parties is as follows:

Prof. Stelle proceeded to Texas, making his headquarters somewhere in the Colorado Bottom, where he was assisted by Judge W. J. Jones, of Virginia Point, near Galveston.

Prof. Barnard made his headquarters at Vidalia, Louisiana, so as to fully study those portions of Louisiana and Mississippi which were neglected in 1878 and 1879 on account of yellow fever.

In Mississippi, Prof. R. W. Jones, of the State University, assisted by Dr. E. H. Anderson, of Kirkwood, and Mr. Lawrence Johnson, of Holly Springs, represented the Commission among the cotton lands of that State.

In Alabama, Judge J. F. Bailey, of Marion, assisted by Mr. James Roane, chemist, of Georgetown, D. C., made a special series of experiments.

In Georgia, Prof. J. E. Willet, of Mercer College, made a series of experiments to test the usefulness of fungus germs in the destruction of the worm, having the aid and advice of W. G. Farlow, professor of cryptogamic botany at Harvard, who has been employed by the Commission to study this subject.

In Florida, Mr. H. G. Hubbard, a well-known entomologist of Detroit, Michigan, who has been for some time stationed at Crescent City, is making a series of practical observations and experiments, having his headquarters at Tallahassee.

Prof. Smith was occupied more particularly with the preparation of maps showing the different cotton regions, and indicating a new classification of the cotton belt with reference to the hibernation of the insect.

Mr. E. A. Schwarz, who has been associated with Prof. Riley from the beginning of the investigation, and Mr. W. H. Patton, an experienced entomologist of Connecticut, remained at the headquarters of the Commission in Washington during Prof. Riley's

absence, and took the field later in the season at points to which future experience may direct. Prof. Riley has been at various points in Mississippi, Alabama and Georgia. He has traveled from point to point superintending the work and advising with his assistants. Towards the end of September he expects to go to California to investigate the facts concerning the cultivation of Pyrethrum, which may prove a valuable and safe antidote to the cotton worm. He has already taken steps to introduce this plant into the Southern States.

In their investigation of the Rocky Mountain locust, Profs. Packard and Thomas have been assisted by Prof. Aughey and Mr. Lawrence Bruner, of Nebraska, Dr. John Marten, of Carbondale, Illinois, and Mr. Allen Whitman, of Minneapolis, Minn. In Utah, Messrs. J. L. Barfoot, Orson Howard and Mr. E. E. Wood, of Chicago, have rendered assistance.

Prof. Packard visited Wyoming and Utah, while Mr. Bruner, his assistant for Montana, left home July 1st, going from Bismarck overland to Fort Keogh, and thence up the Yellowstone valley to Bozeman. When last heard from he was at Helena *en route* for Benton. He was in the field two months.

Prof. Thomas left Carbondale on the 10th of July for an extended exploration of those parts of Dakota and British America which embrace some of the most important regions in the permanent breeding grounds of the locust.

The result of the locust investigations for this season shows a remarkable immunity from the attacks of *Caloptenus spretus*, the species of locust under consideration. A single swarm was observed in Utah, and local scattered flights of inconsiderable importance in Dakota and Minnesota, and Eastern Oregon, near Walla Walla. For the first time for many years Montana has been free from the locust, only scattered individuals having occurred in the Yellowstone valley. The researches of the Commission now carried on for four seasons has cleared up the question of the permanent breeding grounds of the locust, which exists in Montana, in the valleys of the Upper Missouri, the Judith basin and the Yellowstone valley with its tributaries. From this region the swarms visit the border States to the eastward, and also pass down into Utah and Wyoming. Colorado is mostly visited by swarms local to that State, while large swarms have arrived from Wyoming in former years. The second report of the Commission is in press and will appear in November, and the third is in preparation.

The investigation of the locust will be resumed in the spring of 1881, Prof. Packard designing to spend the month of June in portions of Utah, Idaho and Montana, so as to bring the work down to June 30th of next year, when by law the special field work connected with the investigation of the Rocky Mountain locust ceases. It is believed that this locust will never be so destructive as in the

past, and due credit has been given by disinterested persons in Kansas, Nebraska, Colorado and Utah, to the practical value of the efforts of the Entomological Commission in obtaining and diffusing such a knowledge of its breeding habits, migrations and distribution as to abundantly justify Congress in ordering the investigation.

— In a long review of Prof. Hayden's 11th Annual Report of the Geological and Geographical Survey of the Territories in the number of *Nature* for July 22, 1880, Prof. A. Geikie, of Edinburgh, expresses the views of nearly all the scientific men in this country and in Europe, in the closing paragraph, which we transfer to our pages. "There will be, we presume, one further report for 1878—the last year of the existence of the Geological and Geographical Survey of the Territories. Though this mode of annual publication necessarily involves incompleteness, and is apt to overload the reports with unimportant detail, there can be no doubt that the series of volumes issued by this Survey form a permanent record of great value, which for the districts to which they refer, will serve as the basis of all subsequent work. It is not without regret that one can regard the cessation of these volumes. On this side of the Atlantic, where they can be calmly considered apart altogether from scientific rivalry and political entanglements, they have been received with general approbation. It is impossible not to be struck by the largeness of the plan conceived by Dr. Hayden for the scope of his survey. Not geology merely but every branch of inquiry touching the natural history, archæology, geography and meteorology of the Territories, was embraced within his plan, and has been illustrated as far as the means at his disposal would allow. To have conceived this broad and scientific scheme, and to have possessed the administrative power to secure and keep in working concert so large and able a body of observers, are qualities of no mean order, and deserve grateful recognition wherever an intelligent interest is taken in the general progress of science and in that human advancement which scientific progress insures."

— S. S. Haldeman, Professor of Philology in the University of Pennsylvania, died at Chickis, Penna., September 10th. He was born near Columbia, Penna., in the year 1812, and received his education at Dickinson College. He was chosen assistant in the New Jersey Geological Survey in 1836, and in the succeeding year occupied a similar position in the Pennsylvania Geological Survey. While engaged in the latter capacity he made some important discoveries which received marked attention at the time, among them that of the oldest fossil known at that time. From 1851 to 1855 he occupied the chair of Natural History in the University of Pennsylvania. In that year he took the same position in Delaware College, and at the same time became professor of

Geology and Chemistry in the Agricultural College of Pennsylvania. He was the author of numerous articles on conchology, entomology and palæontology, published in the various scientific magazines. His work, entitled "Analytic Orthography," consisting of investigations into the philosophy of language, obtained for him in England, the highest Trevelyan prize over eighteen competitors in 1858.

— Mr. G. D. Smith, of Boston, died of paralysis August 6th, aged 46. He was a member of the firm of Palmer, Bachelder & Co., Boston, but was, from boyhood, a student and lover of nature. He devoted himself especially to the Coleoptera, amassing a collection of about 13,000 species, North American and exotic, probably the largest private general collection of Coleoptera in the country. Mr. Smith published no scientific papers, but aided museums and entomologists by the loan and gift of specimens, and thus fostered the zeal of amateurs and local collectors. He was modest, amiable, generous and most industrious, and a loss to the entomologists of Cambridge and Boston, by whom he was held in high esteem. We understand that Mr. Smith's collection is for sale; it would serve admirably as a general collection for a college or university museum.

— Dr. Charles T. Jackson, well-known as a pioneer in American geology and mineralogy, died at Somerville, Mass., Aug. 29th. He was State Geologist of Maine (1836–8), Rhode Island (1839), and New Hampshire (1840), in 1847–50 was U. S. Surveyor of mineral lands in Michigan. He was the author of many geological and mineralogical essays. Dr. Jackson was born at Plymouth, Mass., June 21, 1805.

— Two eggs of the extinct great auk were sold by auction in Edinburgh recently, both being purchased by Lord Lilford, one at £100, the other at 102 guineas—probably the largest sum ever paid for a single egg, with the exception of that of the moa, a single specimen of which was sold at the same place, in 1865, for £200.

— Messrs. A. F. Gray and R. E. Call invite the coöperation of American conchologists in providing the necessary material for a monograph of the Unionidæ of North America. It is designed to figure the anatomy of every species in detail, hence shells with their animals carefully preserved in alcohol are desired.

— An appropriation bill passed by the U. S. House of Representatives provides for a survey of the Gulf Stream from its origin to the Saragossa sea. The plan embraces soundings, deep-sea temperatures and observations of the currents.

— La Opinion Nacional of Caraccas, Venezuela, is publishing a series of articles by A. Ernst, on injurious insects and their

parasites. The *Miris maidis* and *Empusa muscæ* have been discussed.

— Three excellent papers on the three climates of geology, by C. B. Warring, have lately appeared in the *Penn Monthly*. They are mainly critiques of Croll's speculations.

— Mr. George A. Bates, Naturalist Bureau, Salem, Mass., announces the publication of Life on the Sea-Shore, or the Marine Animals of our Coasts and Bays, by James H. Emerton.

— Prof. A. E. Grube, of the University of Breslau, died June 3d. He was born in 1812, and will be remembered by his valuable treatises on the invertebrates, especially the worms or Annelides, in the knowledge of which he was *facile princeps*.

— Prof. E. B. Andrews, of the Geological Survey of Ohio, and author of one of its final reports, died Aug. 21st, aged 59.

— Gen. A. J. Myer, the head of the U. S. Signal Service, died Aug. 24th, aged 51.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

American Association for the Advancement of Science, Twenty-ninth Meeting, Boston, Aug. 25 to Sept. 1, 1880.—This proved to be the largest meeting of the association ever held, and the members received a right royal welcome from the citizens of Boston. The address of the retiring president, Prof. George F. Barker, was on "Some modern aspects of the Life Question." He said that at the outset a reply to the great question, What is Life? must be evaded by the assertion that the answer is not yet. However, one of the greatest results of modern research has been to establish the fact that living organisms have been brought absolutely within the action of the law of the conservation of energy, and that whether it be plant or animal, the whole of its energy must come from without itself; in fact, an animal like a machine only transforms its energy. Lavoisier's Guinea pig placed in the calorimeter, gave as accurate a heat return for the energy it had absorbed in its food, as any thermic engine would have done. He next referred to the origin of muscular contraction, and arrived at the conclusion that it was due to electrical phenomena, adding the interesting fact that the electrical discharge was not carried to the muscle by the nerve, but was generated within the muscle itself. He said in conclusion that physiologically considered life has now no mysterious passages, no sacred precincts into which the unhallowed foot of science may not enter, and that research has day by day diminished the phenomena supposed to be vital, and that sooner or later every action of the living body will be pronounced chemical or physical."

The address of Mr. Alexander Agassiz, vice-president of sec-

tion B, was entitled, "Palæontological and Embryological Development." The speaker referred to the remarkable parallelism between the embryonic development of the members of a group and its palæontological history. This parallelism, which has been on the one side a strong argument in favor of design in the plan of creation, is now, with slight emendations, doing duty on the other as a newly discovered article of faith in the new biology.

As a demonstration of the truth of such a parallelism, he presented a series of facts and generalizations resulting from his studies of the fossil and recent sea-urchins. In closing he insisted on the impossibility of tracing in the palæontological succession of the Echini anything like a sequence of genera. "No direct filiation can be shown to exist, and yet the very existence of persistent types, not only among Echinoderms, but in every group of marine animals, genera which have continued to exist without interruption from the earliest epochs at which they occur to the present day, would prove conclusively that at any rate some groups among the marine animals of the present day are the direct descendants of those of the earliest geological periods. When we come to types which have not continued as long, but yet which have extended through two or three great periods, we must likewise accord to their latest representatives a direct descent from the older." * * * "Such descent we can trace, and trace as confidently as we trace a part of the population of North America of to-day as the descendants of some portion of the population of the beginning of this century. But we can go no further with confidence, and bold indeed would he be who would attempt even in a single State to trace the genealogy of the inhabitants from those of ten years before. We had better acknowledge our inability to go beyond a certain point; anything beyond the general parallelism I have attempted to trace which in no way invalidates the other proposition, we must recognize as hopeless."

Prof. A. M. Mayer read an eulogy on the late Prof. Joseph Henry. The botanists were entertained at the Botanic Garden by Prof. Asa Gray, who read an essay on the vegetation of the Rocky mountains. Prof. A. Hyatt also gave an evening lecture on the transformations of Planorbis as an illustration of the doctrine of evolution.

The following officers were elected for the next year, the meeting to be held at Cincinnati: president, Prof. G. J. Brush, of New Haven; secretary, Prof. C. V. Riley, of Washington; treasurer, Mr. W. S. Vaux, of Philadelphia; president of section A, Prof. A. M. Mayer, of Hoboken; secretary, Prof. John Trowbridge, of Cambridge; president of section B, Dr. W. H. Engelman, of St. Louis; secretary, Prof. William Saunders, of Canada.

Following are the titles of papers read in section B, natural history and geology:

Comparative anatomy as a part of the medical curriculum. Harrison Allen.
Distinguishing species of Populus and Juglans by the young naked branches. W. J. Beal.
Evidences of the effect of chemico-physical influences in the evolution of branchipod crustaceans. Carl F. Gissler.
Observations on Japanese Brachipoda. E. S. Morse.
An investigation of the peach yellows. B. D. Halsted.
Incomplete adaptation as illustrated by the history of sex in plants. L. F. Ward.
Evolution of parasitic plants. Thomas Meehan.
Anthrax of fruit trees; or the so-called fire blight of the pear and twig blight of the apple tree. T. J. Burrill.
Further notes on the pollination of Yucca, and on Pronuba and Prodoxus. C. V. Riley.
Fossil Dinocerata in the E. M. Museum at Princeton, N. J. F. C. Hill.
Origin and succession of Felidæ. E. D. Cope.
Preservation of fossil insects and plants at Mazon creek. J. W. Pike.
Menobranchus lateralis. P. R. Hoy.
The endocranium and maxillary suspensorium of the bee. G. Macloskie.
Anatomy of the tongue in snakes and other reptiles, and in birds. Exhibition of sections. Charles Sedgwick Minot.
The first decade of the U. S. Fish Commission. Its plan of work and accomplished results, scientific and economical. G. Brown Goode.
Partial revision of the nomenclature of the brain. Burt G. Wilder.
The foramina of Monro in man and the domestic cat. Burt G. Wilder.
The *crista fornicis*, a part of the mammalian brain apparently not hitherto described. Burt G. Wilder.
Plan of the cerebro-spinal nervous system. S. V. Clevenger.
The Cupriferous series in Minnesota. N. H. Winchell.
The excavation of the upper basin and clove of the Kaaterskill, Catskill mountains, N. Y. Alexis A. Julian.
The Pulmonates of the Palæozoic period. J. W. Dawson.
On the summation of muscular contractions. Charles Sedgwick Minot.
Notice of a complete bibliography on Plathelminths. Charles Sedgwick Minot.
Two new methods of fighting injurious insects. A. J. Cook.
Feeling and function as factors in human development. Lester F. Ward.
The metamorphosis of Actinotrocha. E. B. Wilson.
The rhythmical character of segmentation. W. K. Brooks.
The credit of the United States Government. E. B. Elliott.
Additional notes on the army worm (*Leucania unipuncta* Haw.). C. V. Riley.
The Spanish mackerel and its artificial propagation. C. W. Smiley.
Notes on kames and assars of N. E. Iowa. W. J. McGee.
The age of the copper bearing rocks of Lake Superior. M. E. Wadsworth.
Field work by amateurs. Ellen H. Walworth.
Origin of gold placer deposits and formation of nuggets. Thomas Egleston.
Coals of the Galisteo in New Mexico. B. Silliman.
Auriferous gravels of the Upper Rio Grande in New Mexico. B. Silliman.
Extension of the Carboniferous formation in Massachusetts. W. O. Crosby and G. H. Barton.
Subsidence and erosion. A. S. Tiffany.
On maximum synchronous glaciation. W. J. McGee.
The granites in the White Mountain Notch, upon Mount Willard, and their contact phenomena. George W. Hawes.
Eruptive rocks of Mt. Ascutney. C. H. Hitchcock.
Notes on Japanese Pulmonifera. E. S. Morse.
Recent practical results of the cotton worm inquiry by the U. S. Entomological Commission. C. V. Riley.
Mineral discoveries in Western North Carolina. J. T. Humphreys.
Ancient topography in North Carolina. W. C. Kerr.
Recent geology as illustrated in the coast region of North Carolina. W. C. Kerr.
Some points in the structure of mica veins in North Carolina. W. C. Kerr.
A new mode of vein formation. W. C. Kerr.
Condition of the kames and moraines of New England, as bearing upon the date of the glacial epoch. G. F. Wright.

Occurrence of tin at Winslow, Me. C. H. Hitchcock.
On the gravel deposits of Kentucky. J. R. Proctor.
On several horizons of Breccia in Kentucky. J. R. Proctor.
Method of preparing and mounting wings of micro-lepidoptera. C. H. Fernald.
The contributions of the Cambridge Entomological Club to the progress of entomology. B. Pickman Mann.
The life-habits of certain bee flies (Bombyliidæ). C. V. Riley.
Remarks on tree crickets. C. V. Riley.
Remarks on the early stages of Blepharocera. C. V. Riley.
On biological collections of insects. H. A. Hagen.
The occurrence of *Aletia argillacea* in Wisconsin. P. R. Hoy.
The migrations of the Rocky Mountain locust. A. S. Packard, Jr.
On some very rare insect deformities. H. A. Hagen.
Insects from Copal. D. S. Martin.
Some points in the anatomy of the Coccidæ. E. L. Mark.
Structure and development of certain hymenopterous galls. H. F. Bassett.
Notes on North American Galeodes (Solpugidæ). J. D. Putnam.
Contributions of apiculture to science. A. J. Cook.
Address of the president of the Entomological Club of A. A. A. S. S. H. Scudder.
The honey ants of the Garden of the Gods, Colorado. H. C. McCook.
On *Phoxopteris angulifasciana*. C. H. Fernald.
List of Coleoptera hatched from a few hickory twigs. J. L. LeConte.
On the anatomy of *Prodoxus decipiens*. H. A. Hagen.
On the structure of the mouth organs in the Lepidoptera. E. Burgess.
An essay on lightning bugs. J. L. Le Conte.
On the Hessian fly. H. A. Hagen.
On some rare insect deformities. H. A. Hagen.
On the classification of the Tortricidæ. C. H. Fernald.
Generic characters in the Noctuidæ. A. R. Grote.
Scheme of the tenth census for obtaining statistics of untaxed Indians. Garrick Mallery.
Exhibition of stone implements from the river drift of New Jersey. C. C. Abbott.
Indications of a Pre-Indian occupancy of the Atlantic coast of North America, subsequent to that of palæolithic man. C. C. Abbott.
The Dacotah tribes. H. B. Carrington.
Alabaster quarries, flint mines and other antiquities recently found in Mammoth, Wyandot and Luray caverns. H. C. Hovey.
Textile fabrics of the ancient inhabitants of the Mississippi valley. Pt. I. Material. Preparation of material and spinning, illustrated with specimens of bark, spindle whorls, models of spindles and cuts. J. G. Henderson.
Engraved tablet from a mound in Ohio. W. J. Knowlton.
Japanese caves. E. S. Morse.
Ancient agricultural implements of stone. Wm. McAdams.
The Indian question. D. A. Lyle.
The classification of kindred by the N. A. Indians. J. W. Powell.
On the Iroquois languages. Miss Erminnie A. Smith.
On the rank of Indian languages. J. W. Powell.
Remarks on the mound-builders. J. F. Everhart.
Contemporaneous existence of mastodon and man in America. R. J. Farquharson.
Conventionalism in ornamentation of ancient American pottery. F. W. Putnam.
On the occurrence in New England of carvings by the Indians of the north-west coast of America. F. W. Putnam.
Sign language and pantomimic dances among the North American Indians. J. G. Henderson.
The topographical survey of the works at Aztalan, Wis. S. D. Peet.
The military system of the emblematic mound-builders. S. D. Peet.
Improved stereograph for delineating the outlines of crania. A. S. Bickmore.
The uses of the "chungkee stone." Alfred M. Mayer.
Abundance of microscopic forms of life in the central and lateral surfaces of ponds. Eph. Cutter.
The value of the water shed and water supply of the globe. F. L. Capen.
The antiquity of man in Eastern America geologically considered. Henry C. Lewis.